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The Engineer.

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VOL. CXLIV.—No. 3729] LONDON: FRIDAY EVENING, JULY 1, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Admiralty have available for DISPOSAL the DREDGER "ST. PATRICK," lying at Rosyth.
Type, twin screw, bow well barge-loading bucket ladder dredger.
Length between perpendiculars, 174ft.
Length overall, 181ft.
Beam, 33ft.
Moulded depth, 12ft.
Draught light (mean), 8ft. 1in.
Draught loaded (mean), 9ft. 1in.
Gross tonnage, 461.54.
Two sets compound surface condensing engines.
Dredging equipment:
Capacity of baskets, 20 cu. ft.
No. on string, 42.
Depth to which vessel will dredge, 48ft.
Built and engined by Messrs. Lobnitz and Co., Ltd., Renfrew.
The vessel is for sale as and where she lies without any guarantee.
Further particulars, Tender forms, conditions of sale, &c., may be obtained upon application to the DIRECTOR OF NAVY CONTRACTS, Admiralty, Room 62, Princes House, Kingsway, London, W.C. 2.
Sealed Tenders are due at the Admiralty by Noon on Thursday, the 11th August, 1927. 5853

HEATING, &c.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 15th July, 1927, for ACCELERATED LOW-PRESSURE HOT WATER HEATING (Extension) and HOT WATER SERVICE at the Head Post Office and Telephone Exchange, Preston.
Drawings, specifications, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea (cheques payable to the Commissioners of H.M. Works, &c.). The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5855

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—
1. 302 STEEL TYRES for ROLLING STOCK.
2. SLUICE GATES.
3. ONE 48in. Central-drive Type Motor-driven RAILWAY WHEEL LATHE.
Tenders due on the 19th July, 1927, for No. 1, on the 22nd July, 1927, for No. 2, and on the 2nd August, 1927, for No. 3.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 5870

Assistant Civil Engineers required in the Works and Buildings Directorate, Air Ministry. Candidates must be between the ages of 25 and 30 years on the 21st July, 1927; those who have served or are serving in the Army, Navy or Air Force may deduct from their actual age any time, not exceeding five years, during which they have so served. A candidate must be either—
(i) A Corporate Member of the Institution of Civil Engineers; or
(ii) A Corporate Member of the Royal Institute of British Architects; or
(iii) A Corporate Member of the Institution of Municipal and County Engineers; or
(iv) A person qualified to become a Corporate Member of the Institution of Civil Engineers on attaining the prescribed age; or
(v) A holder of a Degree in Engineering or an equivalent diploma; or
(vi) A person who has held a Commission in the Royal Engineers or an appointment in Civil Engineering under the British or Indian Government or a Dominion or Colonial Government, and has been precluded by such employment from obtaining any of the above qualifications.
He must also have served for two years in an engineering firm of good standing or on the engineering staff of a Government or large municipal department or in the Royal Engineers, and have there gained experience in Civil Engineering, both in the Drawing-office and on Important Engineering Works. Special consideration will be given to candidates who served in H.M. Forces during the war.
Successful candidates will serve on probation for two years, and will not be confirmed unless and until they have passed such probation to the satisfaction of the Air Ministry.
Commencing salary, £250 per annum, plus Civil Service Bonus which at the current rate amounts to £127 per annum.
No candidate will be appointed who fails to pass a strict medical examination as to his physical fitness for service at home and abroad.
Copies of regulations and forms of application can be obtained from the SECRETARY, Air Ministry, Adastral House, Kingsway, London, W.C. 2. The latter should be returned completed so as to reach that office not later than the 21st July, 1927.
Candidates must bear any expenses which they may incur in attending for interview. 5868

Assistant Engineers (2) required for the RAILWAY DEPARTMENT of NIGERIA, for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, must have passed Examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had experience in Maintenance and Construction on a recognised Railway in the United Kingdom or a British Colony. A good knowledge of Surveying is essential.—Apply at once by letter, stating age and particulars of qualifications and experience to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,394. 5862

Assistant Engineers (2) required for the NIGERIAN GOVERNMENT RAILWAY SURVEY, for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush travelling and detention allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Salary £480 for the first three years of service, then £510, rising by annual increments to £920 a year. Candidates must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had experience on Railway Survey, preferably Location.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, mentioning this paper, and quoting M/15,135. 5880

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

A Large British Bottle-Making Machine.
THE ENGINEER, 1-7-27.

A New G.W.R. 4-cylinder Engine.
THE ENGINEER, 1-7-27.

The Royal Agricultural Show.
THE ENGINEER, 1-7-27.

The "Mechanicals" Summer Meeting.
THE ENGINEER, 1-7-27.

The Automobile Industry in the Midlands.
(H. KERR THOMAS.) THE ENGINEER, 1-7-27.

Aircraft Carriers.
THE ENGINEER, 1-7-27.

The Trades Disputes Bill.
THE ENGINEER, 1-7-27.

Development on Indian Broad Gauge Railways.
THE ENGINEER, 1-7-27.

A New Portable Air Compressor.
THE ENGINEER, 1-7 27.

A 165-k.w. Oil-Engine-driven Generator Set.
THE ENGINEER, 1-7-27.

INDEX TO ADVERTISEMENTS, PAGE 83.

PUBLIC NOTICES

Civil Engineer Required by the GOVERNMENT of SIERRA LEONE for the PUBLIC WORKS DEPARTMENT, for two tours of from 12 to 18 months' service, with possible extension. Salary £600, rising by annual increments to £720 a year. Outfit allowance of £60 on first appointment. Free passages and quarters and liberal leave on full salary. Candidates, aged 30 to 35, must have served articles with a Corporate Member of the Institution of Civil Engineers and have passed the Examination qualifying for A.M.I.C.E. or hold equivalent professional qualifications. Must be good Draughtsmen, capable of Designing and Carrying Out Buildings, Bridges, and other Engineering Structures, and of Taking-out Quantities and preparing Detailed Plans and Estimates. Must be competent to Execute Surveys and to Lay Out and Construct Roads, and have had experience as Civil Engineers on the Construction of Roads, Buildings and other Public Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15,450. 5861

The Government of BURMA REQUIRE the SERVICES of a SANITARY ENGINEER for the Public Works Department, Buildings and Roads Branch, Burma.
Candidates must have had a thorough academic training in Europe in Sanitary Engineering, particularly water supply and sewerage schemes, and have obtained a recognised degree or diploma. Subsequent to training they must have had at least five years' practical experience in connection with the design and construction of Municipal Water Supply and Sewerage Projects. Age 30 to 35 years.
Five years' agreement. Pay in accordance with an age scale, e.g., age 30, Rs. 725 a month plus overseas pay £25 a month; age 35, Rs. 975 a month plus overseas pay £30 a month. Provident Fund. Free first-class passage to Burma and return passage on satisfactory termination of agreement. (Overseas pay and return passage admissible only to an officer of non-Asiatic domicile.) Strict medical examination.
Forms of application and further particulars may be obtained (upon request by postcard) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 22nd July, 1927. 5859

PUBLIC NOTICES

Assistant Engineers (20) required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtained such other diploma or distinction in engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 5755

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5881

PUBLIC NOTICES

Armstrong College, NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)
COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.
The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.
Full particulars of the Courses may be had on application to
THE REGISTRAR,
Armstrong College,
5805 Newcastle-upon-Tyne.

University of Liverpool.
FACULTY OF ENGINEERING.
DEAN: Professor C. O. BANNISTER, M. Eng., Assoc. R.S.M., F.I.C., M. Inst. M.M.
Prospectus and full particulars may be obtained on application to the REGISTRAR of courses designed for Students desiring to qualify as Mechanical, Electrical, Civil or Marine Engineers, as Naval Architects or as Metallurgists and Metallurgical Engineers. 3807

Borough Polytechnic Institute, BOROUGH-ROAD, LONDON, S.E. 1.
VISITING LECTURER IN STRUCTURAL ENGINEERING DRAWING AND GRAPHICS.
The GOVERNORS REQUIRE in September next the SERVICES of a LECTURER in STRUCTURAL ENGINEERING DRAWING and GRAPHICS for two evenings a week. Remuneration 16s. per evening for Elementary Class and 22s. per evening for Advanced Class.—Particulars and form of application may be obtained from the PRINCIPAL. 5875

City of Birmingham Education COMMITTEE.
HANDSWORTH JUNIOR DAY TECHNICAL SCHOOL.
APPLICATIONS are INVITED for the POST of ASSISTANT MASTER in the above School as from September next. Graduate preferred. Subjects, Geometrical and Mechanical Drawing. Candidates must have had workshop and drawing-office experience.
Salary in accordance with the Burnham Provincial Technical Scale.
Forms of application may be obtained from the undersigned, and must be returned (in envelopes endorsed "H.E. Dept.") not later than the 6th July.
P. D. INNES,
Chief Education Officer.
Higher Education Dept.,
Education Office,
Margaret-street, Birmingham. 5849

Egyptian Government. MINISTRY OF PUBLIC WORKS.
The Mechanical Department is calling for TENDERS for the SUPPLY, ERECTION and WORKING of FOUR ROCK DRILLING OUTFITS. Two Rotary Core Drills and Two Percussive Drills with suitable motive power, spares, &c., are required.
Tender forms, &c., may be seen at the offices of—
CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1,
from whom they may be obtained on payment of 10s., which is not returnable.
Tenders will be received at the above address up to Noon on the 3rd August, 1927. 5863

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PARTNERSHIPS, Page 2.
AUCTIONS, Page 84.
EDUCATIONAL, Page 2.
AGENCIES, Page 2.
MACHINERY, &c., WANTED, Page 3.
FOR HIRE, Page 3.
FOR SALE, Pages 3, 4 and 84.
PATENTS, Page 2.
MISCELLANEOUS, Page 2.
BUSINESSES and PREMISES (For Sale, etc.), Page 84.
WORK WANTED, Page 4.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Administrative County of LONDON.

PUTNEY BRIDGE.—PART WIDENING OF NORTHERN APPROACH.

The London County Council invites TENDERS for the WORKS to be executed in connection with the WIDENING of PART of the NORTHERN APPROACH to PUTNEY BRIDGE, namely, the Extension of Four Arches and the Paving of the Widened Footway.

Persons desiring to submit Tenders may obtain the form of Tender and contract, specification, bill of quantities, drawing, &c., on application, on and after Monday, 4th July, 1927, to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W.1, upon payment of the sum of £2 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

The contractors will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E.1, after 4 p.m. on Monday, 18th July, 1927, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.

5842

B. B. and C.I. Railway Company.

The Directors are prepared to receive up to Noon on Friday, 15th July, 1927, TENDERS for the SUPPLY of:—

BUFFERS FOR CARRIAGES AND WAGONS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, S.W.1,
27th June, 1927. 5841

State Electricity Commission

OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of TWO 10,000 K.W. BACK-PRESSURE TURBO-GENERATORS and ACCESSORY PLANT in accordance with Specification No. 27/56.

Copies of Tender form, specification, &c., will be available upon application to:—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract and specification complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering not later than 14th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

5847

State Electricity Commission

OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of TWO H.P. WATER-TUBE BOILERS and ACCESSORY PLANT and STEELWORK for BUILDINGS, &c., in accordance with Specification No. 27/55.

Copies of Tender form, specification, &c., will be available upon application to:—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract, specification and drawings complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies, £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering, not later than 24th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE.
Acting Secretary.

5856

South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. ELECTRIC OVERHEAD TRAVELLING CRANES.
2. ELECTRIC WALKING CRANES.
3. STEEL CRANKED FISH-PLATES.
4. PUNCHING MACHINE.
5. PLATE-STRAIGHTENING ROLLS.
6. VERTICAL BAND SAWING MACHINE.
7. HYDRAULIC PRESS.
8. ANGLE STRAIGHTENING MACHINE.
9. STEAM MAINS, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W.1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Ltd., marked, "Tender for E.O.T. Cranes," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 22nd July, 1927, in respect of Specifications Nos. 1 and 2, and the 15th July, 1927, in respect of Specifications Nos. 3 to 9.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1, 2 and 3, of 5s. for each copy of Specifications Nos. 4, 5, 6, 7, 8 and 9.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W.1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W.1,
29th June, 1927. 5883

Teignmouth and Shaldon Bridge COMPANY.

RECONSTRUCTION OF THE ROAD BRIDGE OVER THE ESTUARY OF THE RIVER TEIGN BETWEEN TEIGNMOUTH AND SHALDON, IN THE COUNTY OF DEVON.

TENDERS are INVITED by the Teignmouth and Shaldon Bridge Company for the RECONSTRUCTION of the TEIGNMOUTH and SHALDON BRIDGE and APPROACHES, 2200ft. in length, and the CONSTRUCTION of a TOLL HOUSE, &c.

Contractors desiring to Tender should apply in writing to Mr. H. D. Smith, Chartered Engineer, Ivy Cottage, Ivybridge, Devon, the Engineer to the Company, for forms of Tender, conditions and specification and bills of quantities and an order to view the drawings. The application must contain references to the Engineers under whose supervision the contractor has constructed bridge works on cylinder foundations in tidal water, with particulars of the works.

The last day for receipt of Tenders will be Monday, the 8th August, 1927.

EDWARD J. F. TOZER,
Secretary.

2 and 3, Orchard-gardens,
Teignmouth, Devon,
27th June, 1927. 5836

PUBLIC NOTICES

Manchester Corporation Water-Works.

WATER STREET PUMPING STATION.

TENDERS are INVITED for the SUPPLY, DELIVERY and ERECTION of the following MACHINERY in connection with the Conversion of the present Steam-driven Pumping Plant to Electric Driving, viz.:—

CONTRACT No. 15.—ONE Electrically Driven AIR COMPRESSOR, TRANSFORMER, PIPES, VALVES, WIRING, &c.

CONTRACT No. 16.—SIX 200 B.H.P. D.C. ELECTRIC MOTORS, 8-SPEED-REDUCTION GEARS, CABLES, WIRING, &c.

Complete Tenders only will be considered.

Specifications, &c., for each contract may be obtained on application to the WATERWORKS ENGINEER, Town Hall, Manchester, on payment of the sum of Two Guineas for each copy, which sums will only be returned on receipt of bona fide Tenders and of the drawings and documents lent.

Sealed Tenders, endorsed as directed, must be delivered not later than the 19th July, 1927. 5869

Coimisiun Um Stat-Sheirbhis.

POST VACANT.

HYDRO-ELECTRIC DEVELOPMENT ON THE RIVER SHANNON.

APPLICATIONS are INVITED from competent Engineers for a POST as ELECTRICAL MACHINERY ENGINEER, to be filled about next October on the Electrical and Mechanical Staff of the above-mentioned constructional works. Salary £400 per annum, with possible increases to £500 per annum, inclusive.

The appointment, which will be temporary and non-pensionable, will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners.

The latest date for receiving applications, which must be on the prescribed form, is 30th July, 1927. Copies of the form and further particulars may be obtained from the SECRETARY, Civil Service Commission, 23, St. Stephen's Green, Dublin.

8/8536. W.H.Co.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT WORKS MANAGER for large Motor Body Building Shops; well versed in up-to-date methods and economical production, including all classes of Commercial Vehicles. First-class organiser essential.—Write, stating age, experience, and salary required, to Box 923, Advertising Offices, 84, Queen Victoria-street, London, E.C.4. 5867 A

WANTED, INSPECTOR of LIGHT STRUCTURAL STEELWORK; D.O. and Works Experience essential. Confident to accept responsibility; used to handling men an advantage.—Write, stating age, full particulars of experience, with copies of testimonials and salary required, 5832, The Engineer Office. 5832 A

WANTED, WORKS MANAGER for Large Iron and Steel Works. Must be capable organiser and have complete knowledge of Engineering and Manufacture.—Address, with full particulars of experience, age, and salary desired, P3293, The Engineer Office. P3293 A

A GOOD YOUNG ESTIMATOR, with Actual Experience in Steam, Gas and Oil Engines, Compressors and Turbines, REQUIRED by well-known firm.—Address, stating age, experience and salary expected, 5866, The Engineer Office. 5866 A

A LARGE FIRM, Manufacturing Machinery in the Midlands, REQUIRES for its Experimental Organisation, an experienced INVENTOR-DESIGNER; capable of originating and designing machines to eliminate existing hand operations in the manufacture and assembly of a large variety of irregular shaped articles made from flexible materials.—Address, 5851, The Engineer Office. 5851 A

ENGINEER, with Sound Executive Ability and knowledge of workmen, REQUIRED to review present system of large Engineering works in Yorkshire, employing 1000 hands, dealing with small and medium heavy work in varying quantities, with a view to increasing production on the most economical basis, and without interfering with present output.

Must have had previous experience, 7.30 a.m. man, good timekeeper, and not afraid of difficulties or long hours.

Only those having held previous successful positions need apply.

Progressive and permanent post for right man.

Give fullest particulars, age, salary, &c.

Address, 5840, The Engineer Office. 5840 A

REQUIRED IMMEDIATELY, the SERVICES of an experienced ARTESIAN TUBE WELL ENGINEER, to advise on an existing bore-hole for water.—Address, stating fee and experience, 5876, The Engineer Office. 5876 A

SPANISH ENGINEER (Native of Spain or S. America only) REQUIRED for Occasional TECHNICAL TRANSLATIONS into Spanish.—Address, P3362, The Engineer Office. P3362 A

WANTED AT ONCE, FIRST-CLASS CHIEF DRAUGHTSMAN, experienced in Internal Combustion Petrol Engines, and with Railway Experience.—Address, stating salary and full particulars, 5845, The Engineer Office. Only men with the experience specified need apply. 5845 A

WANTED, by Locomotive Works, North-East Coast district, good LEADING DRAUGHTSMAN; also TWO good DRAUGHTSMEN with Shop Experience. One of the latter will be required as responsible Locomotive Estimator, and must be capable of Taking Charge of the Estimates in the absence of Chief Estimator. State age, previous experience and salary required.—Address, 5773, The Engineer Office. 5773 A

WANTED, in the Manchester District, a DESIGNER of A.C. MOTORS and GENERATORS. State age, experience and salary expected.—Address, 5835, The Engineer Office. 5835 A

DRAUGHTSMEN (CAPABLE) WANTED, with knowledge of Mining Machinery. Preference will be given to men with up-to-date Dredge Experience.—Write, stating age, experience and salary required, to Box 133, Sells, Fleet-street, E.C.4. 5857 A

DRAUGHTSMAN (JUNIOR), with Pumping Machinery experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 5829, The Engineer Office. 5829 A

DRAUGHTSMAN, with Experience of Electric Crane Details, also DESIGNER, for Eastern Counties.—Age, experience, salary, references, when free, to Box U.P.D., 95, Bishopsgate, E.C.2. 5872 A

ENGINEERING DRAUGHTSMAN. Fully Competent to Design Reinforced Concrete Bridges, REQUIRED for Temporary Service in Railway Engineering Office in London.—Address, stating age, experience and salary required, 5846, The Engineer Office. 5846 A

FIRST-CLASS DRAUGHTSMAN, Experienced in Conveying and Elevation Plants. State age, experience, previous employers, when at liberty.—BUMSTED and CHANDLER, Ltd., Hednesford, Stafford. 5884 A

FIRST-CLASS DRAUGHTSMAN REQUIRED, London district; experienced in the Design and Details of Boilers, Furnaces and Pipe Work. Preference given to one having a good technical education and workshop experience.—Address, stating age, experience and salary required, 5885, The Engineer Office. 5885 A

SITUATIONS OPEN (continued)

JUNIOR DRAUGHTSMAN REQUIRED.—Reply, letter only, stating age, experience and salary required, GWYNNES PUMPS, Ltd., Hammersmith, W.6. 5850 A

MARKHAM and CO., Chesterfield, REQUIRE TEMPORARY DRAUGHTSMAN, conversant with design and details of Steel-framed Buildings, Bridges and Colliery Structures.—Apply (by letter), stating qualifications, previous experience, and salary required, to CONSTRUCTIONAL DEPARTMENT. 5873 A

REINFORCED CONCRETE DRAUGHTSMAN WANTED by firm of Engineers and Contractors, thoroughly experienced in Making Calculations, Preparation of Working Drawings.—Write, stating age, experience and salary required, 5852, The Engineer Office. 5852 A

REQUIRED, DRAUGHTSMAN DESIGNER. Mechanical and Fuel Combustion Experience desirable. State experience and salary required.—Address, P3376, The Engineer Office. P3376 A

STRUCTURAL DRAUGHTSMAN WANTED. Experience in Power Station Design would be useful. State age, salary and experience.—Address, 5834, The Engineer Office. 5834 A

VACANCIES OCCUR IMMEDIATELY for TWO really first-class DRAUGHTSMEN, capable of Taking Charge of Shaker, Scraper and Belt Conveyor Design Section and Coal-cutter Design Section respectively of the Drawing-office of large manufacturers of Mining Machinery. Quote age, experience and approximate salary. Applications will only be entertained from men of outstanding ability and initiative.—Address, 5860, The Engineer Office. 5860 A

YOUNG Capable DESIGNER REQUIRED with sound experience of Modern Screwing Machine Design, to eventually Take Complete Charge.—Address, 5795, The Engineer Office. 5795 A

VACANCY for CHARGE HAND AUTO. SETTER, able to set up Potter and Herbert Chucking Machine.—Apply, stating age and full experience, to JOHN I. THORNYCROFT and CO., Ltd., Basingstoke. 5859 A

SITUATIONS WANTED

A M.I. MECH. E. (ex R.E.), 18 Years' Foreign Experience S. America and China, locomotive and commercial engineer, DESIRES POSITION OF RESPONSIBILITY in London; good testimonials; organiser.—Address, P3380, The Engineer Office. P3380 B

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TO LIBRARIES AND INSTITUTES.—"THE ENGINEER," 1878 to 1928 inclusive, last eleven years unbound. Any offers?—H., "Brisbane," Grange-road, Deal. P3374 I

For continuation of Small Advertisements see page 3.

JULY 1, 1927.—VOL. CXLIV.

THE ENGINEER.

A Seven-Day Journal

Steam Trials of H.M.S. Suffolk.

H.M.S. SUFFOLK, the first of the five "County" cruisers of the 1924 programme to be laid down, is to be commissioned for trials at Portsmouth to-day—July 1st. She was begun at Portsmouth Dockyard on September 30th, 1924, and was launched on February 16th, 1926, and is expected to leave in November for the China Station. The Suffolk is the first British cruiser to be built under Washington Treaty rules, which impose limits on the displacement and armament. She has a length of 590ft. between perpendiculars, an extreme breadth of 68ft. 4in., and a draught of 16ft. 3in. at the "standard" displacement of 10,000 tons. This figure, however, does not include either the 3400 tons of fuel oil which her bunkers can accommodate, or the reserve feed water. The displacement at full load will therefore be very nearly 14,000 tons. The machinery consists of Parsons geared turbines designed for 80,000 shaft horse-power and a speed of 31·5 knots. The unusually large fuel capacity indicates that radius of action, rather than very high speed, has been aimed at in this design. The main armament is eight 8in. guns in twin turrets. Bulges are fitted to minimise the effect of underwater attack, but armour protection is limited to a vaulted steel deck over vital parts. Twelve further ships of similar design are now under construction, including two for the Australian Navy. The cost of the Suffolk, complete with guns, is officially returned at £2,017,928. The machinery trials will be under the direction of Engineer-Commander H. R. Baker, who was appointed to the ship eighteen months ago.

Aeronautical Developments.

IT is reported that the Air Ministry regards the tests that have been made with the Cierva auto-gyro flying machine as sufficiently successful to justify a decision to order an auto-gyro seaplane to be driven by a 450 horse-power Bristol "Jupiter" engine. If the report is correct the new machine should prove of very considerable interest, not only because of the fact that it will represent the first adaptation of the auto-gyro principle to a marine machine, but because of the increase in power which it will represent. The auto-gyros previously constructed have been driven by engines of about 120 horse-power. Another interesting aeronautical development reported this week is the advent of a new Fokker design of commercial machine, the chief characteristic of which is the fact that while the general framework is built up of steel tubing, &c., fastened by welding, its wings are covered not with fabric or sheet metal, but with thin sheets of three-ply wood. The machine is driven by a Bristol "Jupiter" engine, and is designed to carry fifteen passengers in its saloon.

South African Wireless Beam Service.

THE short-wave wireless beam stations which have been built by the Marconi Company for communication with South Africa have successfully passed their Post Office seven-days' test, and are now ready for giving a direct wireless telegraph service between London and Cape Town. These stations constitute the third group of wireless beam stations to be completed for direct communication with the Dominions, the beam services with Canada and Australia being already in operation. It is expected that the fourth and last group of the Imperial wireless beam stations now under construction will be completed next month, when the services with India will be opened. The first tests carried out with the South African stations showed that communication between England and South Africa could be maintained for a longer period than the eleven hours specified under the conditions of the Marconi guarantee, but as the test proceeded it was found that the wave length originally selected was too long to give the maximum period of communication during the hours of daylight, and it became obvious that by a substantial change in wave length a great improvement on the guarantee could be secured. The change of wave length necessitated certain modifications, not only in the transmitter itself but also in the aerial and feeder systems. These alterations took some time to complete, but they have now been successfully carried out, and the official tests, which took place between June 17th and 24th, demonstrated that using two wave lengths, the stations are capable of carrying on a high-speed duplex commercial service between London and Cape Town for the greater portion of the day and night, although the contract only calls for eleven hours per day. The Marconi Company estimates that the stations are capable of handling about 160,000 words per day in each direction.

A New Isle of Man Turbine Steamer.

ON Wednesday morning, June 29th, the new cross-Channel passenger steamer Ben-My-Chree left Liverpool on her maiden voyage to the Isle of Man. She was built by Cammell Laird and Co., Ltd., at Birkenhead, to the order of the Isle of Man Steam Packet Company, and is the fourth vessel of her name. The new Ben-My-Chree has a length of 355ft., with a breadth moulded of 46ft. and a depth moulded of 26ft. 6in. to the shelter deck. She is built to carry 2400 first and third-class passengers, and has a designed speed of 22 knots. With her straight stem and elliptical stern, two steel masts and a single funnel, the vessel presents a pleasing appearance. There are five decks, with a boat deck 186ft. long and a promenade deck with a length of 255ft. A large portion of the promenade space can be shut off from bad weather by frameless sliding windows, built into the side of the ship. The public and general passenger accommodation is of a high order, and the most recent navigational and safety appliances have been fitted. The propelling machinery comprises a twin-screw arrangement of Parsons single-reduction geared turbines constructed by the builders which gave on trial a total output of 11,000 S.H.P. Steam is supplied by two double-ended and two single-ended boilers which are oil fired and work under forced draught. The boilers are constructed for a working pressure of 220 lb. per square inch. A very full complement of auxiliary machinery is provided. Electric current is furnished by two 120-kW generator sets in the engine-room and an emergency set on the main deck. The keel of the Ben-My-Chree was laid on November 29th, 1926, and in spite of the unavoidable delay occasioned by the coal dispute, she was launched on April 5th last, and was delivered to contract time. It is understood that the building of a cross-Channel steamer within a period of less than seven months from the laying of the keel constitutes a new record. Last week the new vessel underwent successful measured mile and endurance trials, and the maximum speed attained was close upon 23 knots.

A Threatened Timber Shortage.

THE annual report of the Forestry Commissioners, issued at the end of last week, calls attention to the unsatisfactory outlook for timber supplies throughout the world. In those countries, such, for example, as North America, in which industrial development has proceeded at a great pace, the consumption of timber has increased and the resources are being exhausted at an unprecedented rate. The Commissioners, dealing with the position in this country, state that the census of woodlands taken in 1924 revealed a much less satisfactory state of affairs than was anticipated in 1916–17 when the Commissioners drew up their policy and programme. Of timber over eighty years old there remain 70,330 acres of conifers and 77,180 acres of indifferent mixed woods, or the equivalent of about nine months' consumption of saw timber. This timber so far as it is accessible will probably be felled within the next few years. Of timber between forty-one and eighty years old there are 244,520 acres of coniferous and 134,410 acres of mixed woods. These woods are now being felled for revenue purposes. Behind them there are only 153,940 acres of coniferous and 63,430 acres of mixed woods of from twenty-one to forty years' growth. Until the post-war plantings begin to become effective, it is fair to assume from these figures, according to the report, that the position as regards reserves of standing coniferous timber will grow steadily worse. In 1916–17 it was assumed that the 3,000,000 acres of existing woodlands would be maintained in a productive state and the programme drawn up proposed the addition of 1,770,000 acres of new forest. The report, however, predicts that unless the planting by the State exceeds the rate of 30,000 acres per year proposed in 1916–17 it will be 1955 before the area of productive forest in this country regains the 3,000,000-acre figure of ten years ago.

The New Argentine Cruisers.

IN view of the discussion at the Geneva Conference on the proposal to restrict the dimensions and armament of future cruisers, special interest attaches to the new ships of this type which the Argentine Government has ordered in Italy, and of which we are able to give authentic details. The Almirante Brown and Vinte-Cinco de Maio, as they are to be named, will be sister ships of 6500 tons, 165 m. in length and 17·7 m. in breadth, propelled by turbine machinery of 85,000 shaft horse-power at a speed of 32 knots. In designing these ships the Italian constructors have broken away from the traditional practice of arming cruisers of moderate displacement with nothing heavier than 6in. guns. Each vessel is to carry six 7·5in. 50-calibre guns in twin turrets. Two turrets are to be placed forward, the second being raised to permit of axial fire, and the third turret is to be on the quarter-deck. Not only in weight of projectile—200 lb. as against 100 lb.—but in all other ballistic qualities as well, the 7·5in. gun is far more powerful than the 6in. The new ships should therefore be greatly superior in fighting power to foreign ships of heavier displacement, which are armed only with 6in. guns. The secondary battery comprises twelve 4·7in. guns, paired in turrets on high-angle mountings, and six 40 mm. pom-poms. There will also be six 21·7in. torpedo tubes on deck carriages. The maximum fuel supply is 2000 tons of oil, and the complement of each ship 600 officers and men. All the boiler uptakes are led into a single large funnel, with a sloping base. The foremast is a heavy tripod, carrying the gun director towers. In proportion to their displacement, these vessels are the most formidable cruisers which have yet been designed for any navy.

The Shipley Electricity Supply.

ON Thursday last, Sir Andrew Duncan, Chairman of the Central Electricity Board, inaugurated the 33,000-volt supply of electricity to the Shipley Urban District Council, this being the first ceremony of its kind since the establishment of the Board. The district, which originally had a generating station of its own, will be supplied in future from the extensive system of the Yorkshire Electric Power Company, which has large generating stations at Ferrybridge, on the river Aire and at Thornhill, on the river Calder. The company also owns a third station near Barnsley, where the power is largely derived from surplus coke oven gas. The current generated at these stations is distributed through a network of mains which supply various distributing undertakings in bulk and many power users direct. The supply for Shipley passes through the company's 33,000-volt sub-station at Rodley and is then transmitted to Shipley by duplicate mains having a total capacity of 30,000 kilowatts. At the Shipley sub-station the pressure is reduced to 6300 volts for the Shipley supply and to 11,000 volts for intereconnection with the company's local high-pressure distribution system. Twenty-six years have elapsed since the original station at Shipley was put into operation, and the average increase in the sale of electricity has exceeded 200,000 units. By closing now the old station and by taking the supply from the much larger and more modern stations of the Yorkshire Electric Power Company considerable economies are expected to be brought about, and it is hoped that the consumers in Shipley will reap the benefit of the change.

Literature.

Coal Carbonization. By JOHN ROBERTS, M.I. Min. E. London: Sir Isaac Pitman and Sons. 1927. Price 25s. net.

Oil and Retortable Materials. By GEORGE W. HALSE, B.Sc. London: Charles Griffin and Co. Price 7s. 6d. net.

THESE two books, by different authors and published by different firms, deal with one of the most important subjects of the hour, and they should be purchased and read as complementary one to the other. Engineers and chemists interested in the subjects of coal carbonisation and the future of our supplies of liquid fuel are advised therefore to add them to their libraries, and to study them carefully; for though entirely different in manner and treatment, they contain facts and figures of the greatest importance in relation to the future of our supplies of fuel in this country.

Mr. Roberts' volume forms one of the Specialist Series now being published by Sir Isaac Pitman and Sons, and it covers both the high and low-temperature methods of coal carbonisation. Its purpose, as set forth by the author in the preface, is to enable coal producers and coal users to obtain a clear grasp of the principles and processes of coal treatment which are being proposed or applied for the manufacture of coke and semi-coke and for the recovery of by-products from coal. With regard to the production of semi-coke, the author states that as the result of experimental work of the last twenty years, and more especially the last six years, several processes have attained the stage of industrial operations, and many firms are now prepared to erect plant of different types for the production of semi-coke, either on a guaranteed basis or under some system of profit-sharing. The first twelve chapters of the thirty-three into which the book is divided deal with the chemical and physical constitution of the raw material—coal—and with the theory and principles of carbonisation. The next seven are devoted to low-temperature processes, and the following eight to the high-temperature processes. Of the remaining six, three are devoted to Gasworks Practice, and one each to the very important subjects of By-product Recovery, the Manufacture of Semi-coke in Bulk, and the Production of Oils from Coal.

Considerable space is allotted in the seven chapters dealing with the low-temperature processes to the descriptions of retorts and plants which have proved unsuccessful, and are no longer operated. The author explains in his preface, however, that he has purposely discussed these failures at some length in order the more adequately to trace the developments which have occurred, and also as a warning to future investigators of the pitfalls that await them, along certain lines of exploration. Practically all types of low-temperature carbonisation retorts that have been tried upon a semi-industrial scale, or are now undergoing trial, are described in this portion of the book; and many readers, no doubt, will find these chapters of most interest. The reviewer considers, however, that Dr. Roberts has not given sufficient space or consideration to the subject of the low-temperature tars, and of the other by-products, for the real difficulty which is delaying the development of low-temperature carbonisation is that of finding a profitable use and an expanding market for the oils and tars produced. They differ both in chemical constitution and in physical characteristics from those obtained by the high-temperature processes of carbonisation, and until a market can be created for these liquid by-products the cost of semi-coke will remain high as compared with that of other forms of solid fuel. Its use will be confined, therefore, to those altruistic people who are willing to pay rather more than they at present pay for coal, in order to obtain a smokeless fuel.

The author in Chapter XXXII. of the book describes a method of manufacturing semi-coke in bulk, which overcomes this particular difficulty; for this process is worked at a considerably higher temperature than the low-temperature processes, and can be operated with the ordinary coke oven plant. As this process may become of considerable importance, the following extracts relating to it are given here:—

"The system proposed for the manufacture is the employment of efficiently heated modern narrow ovens, operating under high-temperature conditions, with flue temperatures up to 1400 deg. Cent. or higher. In most cases blends of coking and non-coking coal with or without coke breeze should be used, the optimum blend being determined in the laboratory in every case. Uncompressed charges of suitably crushed coal to be charged by top charging. The charges should be pushed when the temperature in the middle reaches about 600 deg. Cent., and then quenched. Owing to the fact that volatiles would be coming off in quantity during the discharging operation, it would be necessary to discharge into suitable chambers."

"Obviously as the full coking period for a 14-ton charge in a 14in. oven is eleven hours, this period would be considerably reduced when running for domestic fuel, so that the ovens would be discharged at least three times per twenty-four hours. In this manner each oven should have a through-put of not less than 40 tons of coal and 32 tons of semi-coke per oven day. This figure will, of course, appear startling for those accustomed to think in hundredweights; and we wish to make it clear that we make these claims on our own responsibility. But we have every confidence in the system as being the solution of the problem of producing semi-coke in bulk. When smokeless fuel is produced in coke ovens on a grand scale, the coal-mining industry will then be raised on a plane level with that of the shale oil industry, and instead of supplying the public with a raw material mine managers will dispose only of finished products."

It is not quite clear why the author has made use of the editorial "We" in describing this process, but if the claims made for it can be substantiated, it would seem clear that all the processes now classed as low-temperature processes are doomed to failure, and that the space which he has devoted to describing them in the present work is quite out of proportion to their ultimate importance.

The final chapter of the book only covers six pages, and deals with the very important subject of the production of oil from coal by the Bergius, Patart and Fischer processes. The space devoted to these processes appears to be quite inadequate, and if the author had devoted more space to them and rather less to the processes which he considers are doomed to failure, the book would have been better balanced and more useful to chemists and engineers.

The volume is well printed and produced, but if a second edition is called for it would be advisable to provide it with a more comprehensive index.

Mr. Halse's volume is a small handbook upon the utilisation of coal, torbanite, cannel and oil shales, and the author tells us in his preface that it is specially designed for the non-technical reader, in order that he may be in a position to form reliable judgments concerning the future of oil fuel supplies in this country. It is divided into eight chapters, describing briefly the various processes for obtaining liquid fuel from coal and other raw materials named in the sub-title.

Chapter I. contains a well-written and interesting account of the history of coal and petroleum, since the time they were first placed on the market down to the present date, and is illustrated by two diagrams showing the very striking increase in the world's output of coal in the years 1895 to 1915, and the still more remarkable increase in the production of petroleum, in the period which has followed the close of the war. The author's remarks on these diagrams are quoted here:—

"Fig. 1 shows on different scales the world's coal and petroleum production since 1895. The decrease in coal and the extraordinary increase in oil since 1913 brings out strikingly the rapidly rising importance of oil as a world source of power. The manner in which oil is replacing coal is shown clearly in Fig. 2, in which the world's oil production is plotted as the percentage of the world's coal production for each year. It seems certain that on account of economic conditions the rapid rise in this curve during the last few years cannot be maintained; for even if the oil be reasonably available the cost of again doubling the output in a five-year period, as happened from 1918 to 1923, would be so high that it would mean selling the oil at a loss; or, to put it the way it comes about, if no loss is to be incurred the cost of producing oil at so fast a rate of increase would necessitate selling prices sufficiently high to curtail the demand; hence, the rate of increase of oil production could not be maintained. This statement is based on the fact that the most obvious and easily accessible oilfields are on the decline, and the improvement of production methods together with the discovery of new oilfields is taking place at a slower rate than the rate at which the known supplies of oil are being depleted. In these circumstances, coal seems destined to retain its position as the chief fuel in the world for a long time."

In Chapters II. and III. the author describes the various types of coal and the torbanites and cannels, while in Chapters IV. and V. the oil shales and the correlation of fuels are dealt with. In the former chapter he makes the remarkable statement that the tar sands of the Athabasca River region of Alberta, Canada, contain enough oil to supply the whole world for many years, since they are in some places 220ft. thick and have an area of 10,000 square miles. So far as the United States are concerned, he states that although the present supplies of petroleum can be relied on for the requirements of the next few decades only, the oil shales, cannels and torbanites will produce oil for the needs of centuries.

Chapter VI. deals with the history and principles of what the author calls "Retorting," that is, the dry or destructive distillation of solid fuels. The history of retorting dates back centuries, for the first patent was granted in England in 1627 to Sir John Hacket and Octavious de Strada, for treating coal in order to make it smokeless and suitable for burning in houses in place of charcoal.

Chapter VII. on distillation products is an interesting and valuable contribution to the discussion of the subject, and deals very largely with the low-temperature processes of carbonisation. The author states that a low-temperature tar bears some resemblance to Russian crude oils, but differs from them in the content of phenols. It may be worked up into the following products:—Motor spirit, 3 to 4 gallons; gas oils, 1 to 3 gallons; paraffin, half to 2 gallons; illuminating oils, 1 to 3 gallons; lubricating oils, nil to 2 gallons; pitch, 4 to 6 gallons; disinfectants, dyes, &c., 3 to 8 gallons.

Chapter VIII. upon the future liquid supplies, summarises all the facts and arguments in the book, and the following passage from it may be quoted:—

"It must be abundantly evident from the facts already mentioned that any serious shortage of liquid fuel within the next few centuries may safely be regarded as a somewhat remote possibility. On the other hand, it is hardly conceivable that petroleum from wells can continue to be the chief source of liquid fuels for more than a few decades; but the knowledge of the vastness and the certainty of the oil available from oil shales, cannels and torbanites allows us to contemplate the inevitable decadence of present sources of petroleum with equanimity. In addition, the known and measured coal reserves of the world will, by processes which have been proved practicable, provide ample oil to banish the spectre of a possible shortage many centuries further away. Finally, there is practically no limit to the amount of alcohol which may be produced when economic conditions allow of it."

Movable Bridges: Part II., Machinery. By OTIS ELLIS HOVEY, B.S., M. Am. Soc. C.E. London: Chapman and Hall, Ltd. 1927. Price 30s.

IN a book hardly exceeding 300 pages, excluding forty-two pages of mathematical data in appendices, Mr. Hovey has, as far as American practice is concerned at any rate, presented his subject in such a manner as to serve the purposes alike of the engineer who is designing opening span bridges and of the competent mechanical engineering assistant charged with the heavier labours of designing in detail. Nor does the author assume that a knowledge of machinery design in general will bring the users of his book up to those points at which specialisation of form begins, for his discussions of design are based on first principles and include the mathematical paths leading to acceptable dimensions.

The descriptive matter is limited to a chapter in which there are descriptions of the machinery for typical forms, including swing bridges, draw bridges, and the Chicago and Strauss types of bascule bridges, illustrated verbally and pictorially by examples of important cases. These include Kalan Bridge, with five two-page drawings; Sacramento River Bridge, with drawings of the general arrangement of the machinery and of important details; and other useful examples. The various mechanisms and elements of machinery are dealt with in detail, the mathematical treatment being accompanied by notes on practical details and by discussions of the nature and purpose of each part, by means of which the reader is kept in touch with that purpose and sees the part in its relation to the whole.

Besides the short chapters on the simpler parts of the machinery, there are some of considerable length on Gearing; Brakes; Shafts, Couplings and Keys, the relative importance of the various parts being a matter as to which the author, who is assistant chief engineer of the American Bridge Company, is well qualified to judge. There is also a chapter on Machinery Resistance and Motor Torques and one in which the elements of Hydraulic Machinery are discussed, so that there is some justification for the author's description of his book, from the fifth chapter onwards, as " . . . intended to be used as a manual of design for heavy slow-moving machinery, whether for movable bridges or for other purposes." The author's specification for movable bridges, separately indexed, is a useful feature, while his study of sheaves loaded by ropes under tension may also be commended.

The book is well printed and is furnished with suitable drawings, diagrams, graphs and tables, and in consideration of the fact that fully illustrated papers describing specific works are easily accessible and furnish material for general comparisons and suggestions, the author may be considered to have decided wisely as to what treatment of the subject is likely to be most acceptable to those responsible for the design of the machinery of opening span bridges.

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Annales des Travaux Publics de Belgiques. 80me Année, Juin, 1927. Brussels: Goemaere, Rue de la Limite 21.

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Public Works Department, Madras Presidency Administration Report, 1925–26. Part II., Irrigation. Madras: The Government Press. Price Rs. 2.

Annales des Ponts et Chaussées, 1927. Fasc. 2, Mars-Avril. (1) Partie Technique; (2) Partie Administrative. Paris: A. Dumas, 6, Rue de la Chaussée-d'Antin.

L'Enseignement Technique—Bulletin mensuel du Musée Professionel de l'Etat à Morlanwelz-Mariemont—16e Année, No. 4, Avril, 1927. Published by the Museum at Morlanwelz. Price 2f.

Berechnung vielfach statisch unbestimmter biegefester Stab-und Flächentragwerke. 1 Tiel, Dreigliedrige Systeme. By Dr.-Ing. Peter Pasternak. Zürich: A.-G. Gebr Leemann and Co. Price 13 marks.

A Large Bottle-making Machine.

No. I.

IT may be remembered that in our issue of October 16th, 1925, we described a glass bottle-making machine, made to the designs of Mr. F. Redfern, of 12, Mark-lane, London, E.C. 3, by the Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park, Manchester, and installed in the works of John Lumb and Co., Ltd., at Castleford, near Leeds. We then described it as being a great advance on anything of the kind which had so far been produced, and congratulated those concerned in breaking down what had previously been an almost complete American monopoly in the provision of bottle-making machines. At that time there was evidence of further advances, as work had been started on two larger machines, but it was considered inadvisable to enlarge upon them until they were completed. These two machines have been made by the same company for the Mitsubishi Shoji Kaisha, Ltd., of Japan, and one of them, which has just been finished—the other will follow in the course of a month or so—is illustrated by the engraving, Fig. 1 above. We recently had an opportunity of seeing this machine running, but it was not, for obvious reasons, making bottles, as the cost of installing the necessary glass-making tank and revolving pot would be prohibitive. The machine was, nevertheless, performing all the actions of making bottles, and the only difference between the trial conditions and those of actual practice was the fact that the moulds were not subject to the heat of the molten glass. That matter cannot, however, have any material effect on the mechanism of the machine.

The outstanding difference between the new machines and that which we have already described, is the provision of fifteen bottle-making units round one centre, in the place of ten units in the original machine, and a general enlargement to make provision for a wide variety of work. Thus, the new machines will make bottles ranging in height from 2½in. up to 15in. The maximum size of finishing mould which the machine will accommodate is 9in. in diameter, and the maximum size of ring mould is 5½in. in diameter. The process of making the bottles remains the same, but the mechanism for performing the various functions has been altered considerably, so it may be as well to recapitulate briefly the process of making a bottle, and then to go on to a comparative description of the mechanical details of the two machines.

The bottle-making units are grouped about a central column, round which they revolve in proximity to a pot of melted glass. Each unit produces a bottle in the course of one revolution round the column, and as the machine can be run up to a speed of six revolutions per minute, as many as ninety bottles a minute can be produced. Considering any one unit, it is provided with a split mould carried by two arms from an upper head. As the head passes over the surface of the glass pot, the mould is dipped down and a vacuum sucks it full of molten glass. The mould then rises and any glass trailing out of the hole in the bottom is cut off. In this way a solid blank, or "parison," of plastic glass is produced. A puff of compressed air is admitted at the top and forms a slight cavity in the neck. The blank moulds then open, but the blank does not fall, as it is carried by a pair of ring moulds holding the extreme upper end. By this time the unit will have passed well away from the glass pot, and there is space for another pair of moulds to rise up from below and embrace the hanging blank. These moulds represent the finished form of the bottle, and the blank is blown out into them by a further supply of compressed air. The bottle is then released by the ring moulds, the finishing moulds, still holding the bottle, drop to clear the glass pot, and finally the bottle is ejected just in time to release the moulds to accommodate the next blank. And so the process is repeated at each head.

The machine under review has been so devised that it can make simultaneously ten different types of bottle. This feature, together with the increased accommodation provided by the larger overall dimensions, has been responsible for many of the changes in the details of design described below. In order to facilitate the explanation of these changes, we reproduce again one of the drawings from our original article in Fig. 2, while Fig. 3 is a corresponding drawing of the new machine.

Following the same routine of description as before, we first come to the rotating foundation ring on which the fifteen units are built up. Originally the columns of the units rose directly from the ring as shown in Fig. 2, but in the new machines the diameter, overall, has had to be increased to accommodate the greater number of units, so a flat ring has been mounted above the slide ring to form a table. This ring is plainly shown at Z in Fig. 6, and is about 11ft. 3in. in diameter. Incidentally, it will be noticed that the form of slide ring adopted for the Castleford machine has been retained.

In connection with the flat ring, some rather interesting experiments were made at the makers' works, as upon its rigidity depends to a large extent the maintenance of the proper alignment of the whole machine. Two cast iron rings were made for the two machines, but instead of having the cross-sectional contour shown in Fig. 6, they had a continuous taper. Some calculations were made in an endeavour to determine the amount by which the ring would deflect under the load it had to support, but these calculations were naturally inconclusive, as the deflection of such a ring is indeterminable. In consequence, a one-tenth scale model was made, and was tested to destruction. At the rated load the deflection was considerably less than that indicated by the calculations and came within reasonable limits. When the ring failed the fractures were principally radial. It was, however, considered that the suitability of the rings had not been conclusively proved, so they were set up face to face, with distance pieces between at the positions of the units. Then a hydraulic jack was used to pull the two rings together at the centre. This experiment confirmed the test of the model and showed a deflection of ·055in. at a load of 80 tons. Even this small deflection did not satisfy Mr. Redfern. The rings were discarded and their places taken by others of the form shown in Fig. 6, and made of cast steel. From the foregoing it will be seen how great an importance the designers have attached to general rigidity, and there is no doubt that this feature accounts for the easy, vibrationless running of the machine and the accurate registering of the complicated parts forming the bottle moulds.

The ring is driven by a worm meshing with teeth cut in its periphery, through a two-speed gear-box

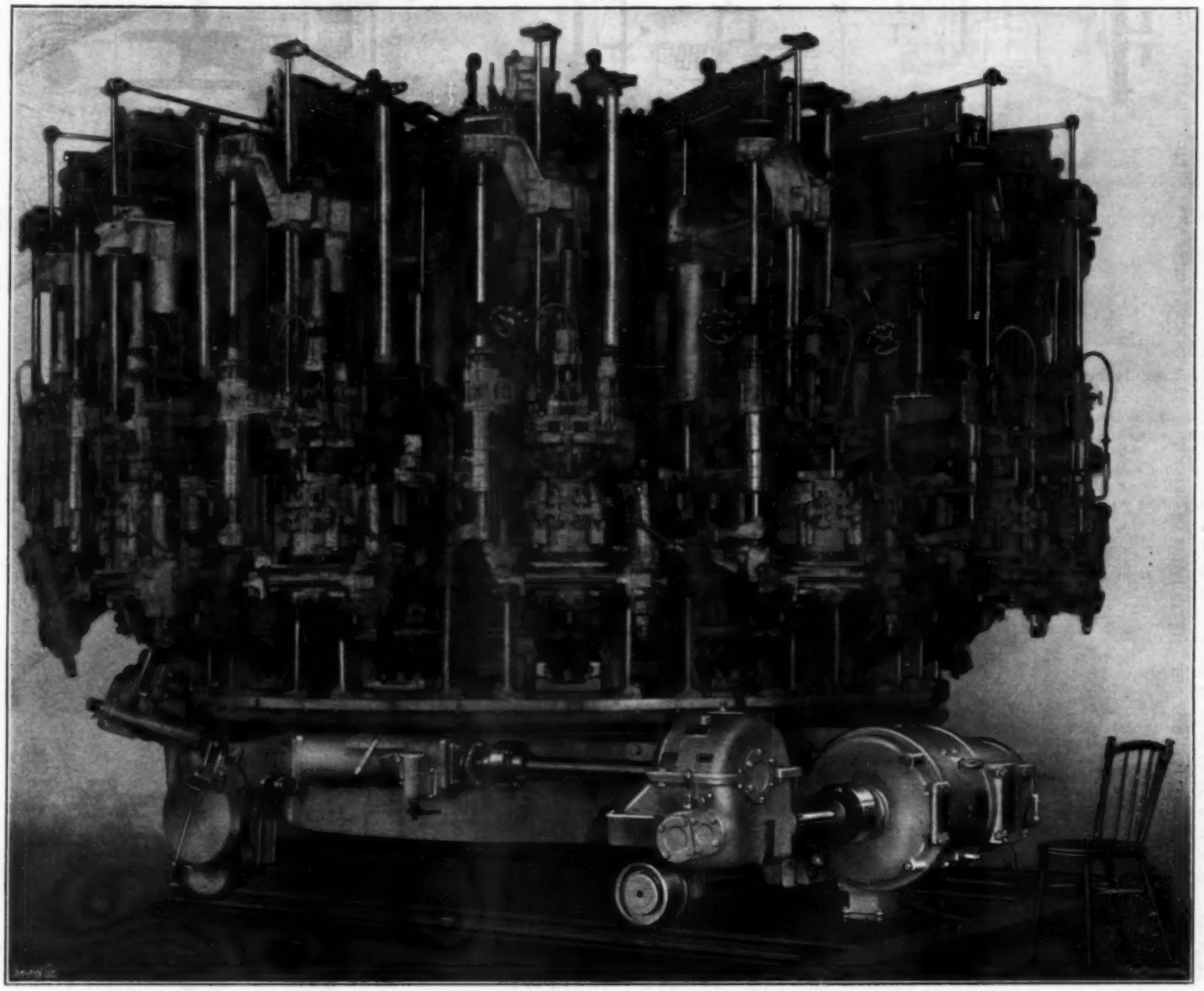


FIG. 1—FIFTEEN-ARM BRITISH GLASS-BOTTLE-MAKING MACHINE

TEN-ARM AND FIFTEEN-ARM GLASS-BOTTLE-MAKING MACHINES

DESIGNED BY MR. F. REDFERN AND MADE BY THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., TRAFFORD PARK

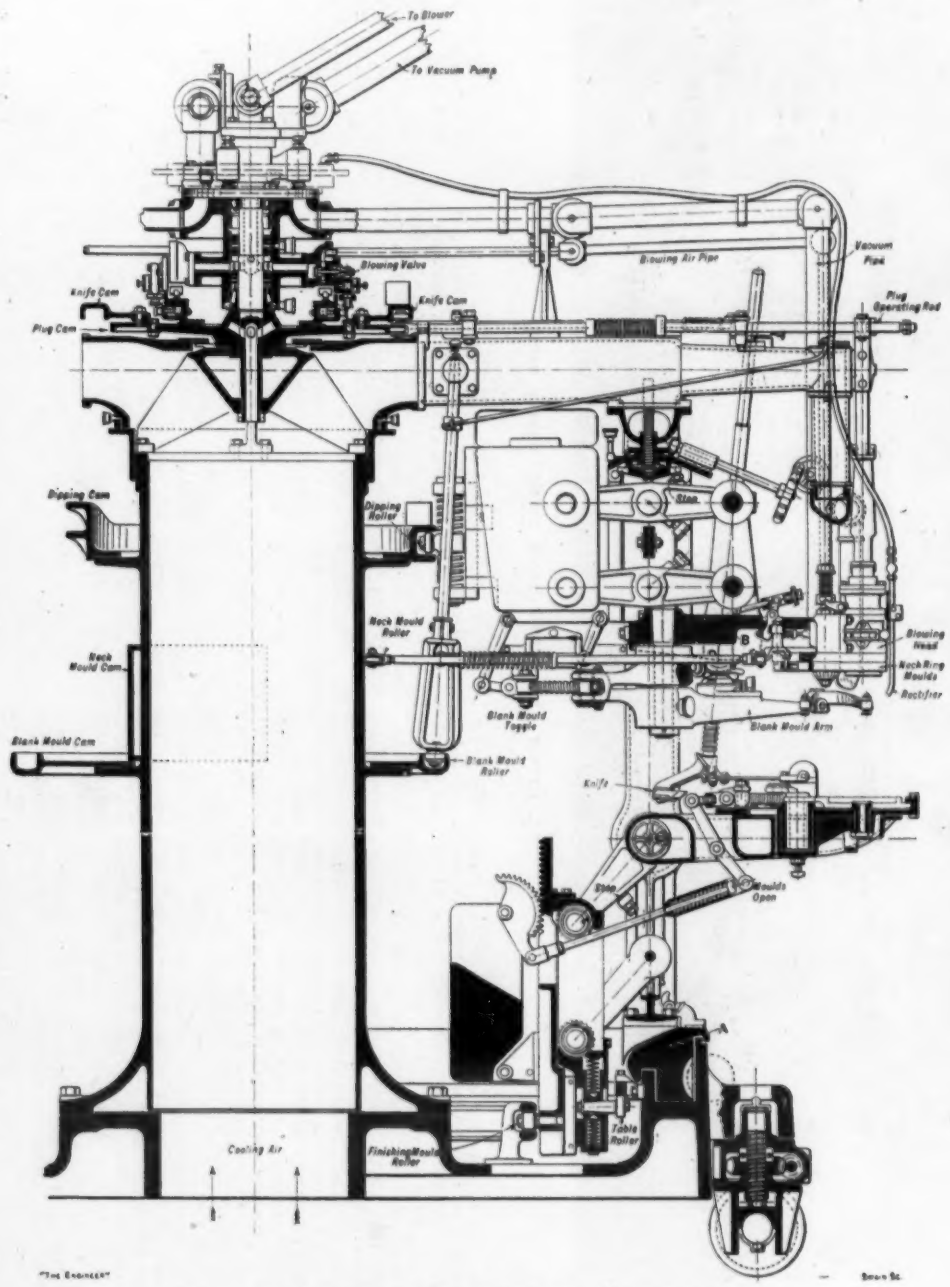


FIG. 2—CROSS SECTION THROUGH TEN-ARM MACHINE

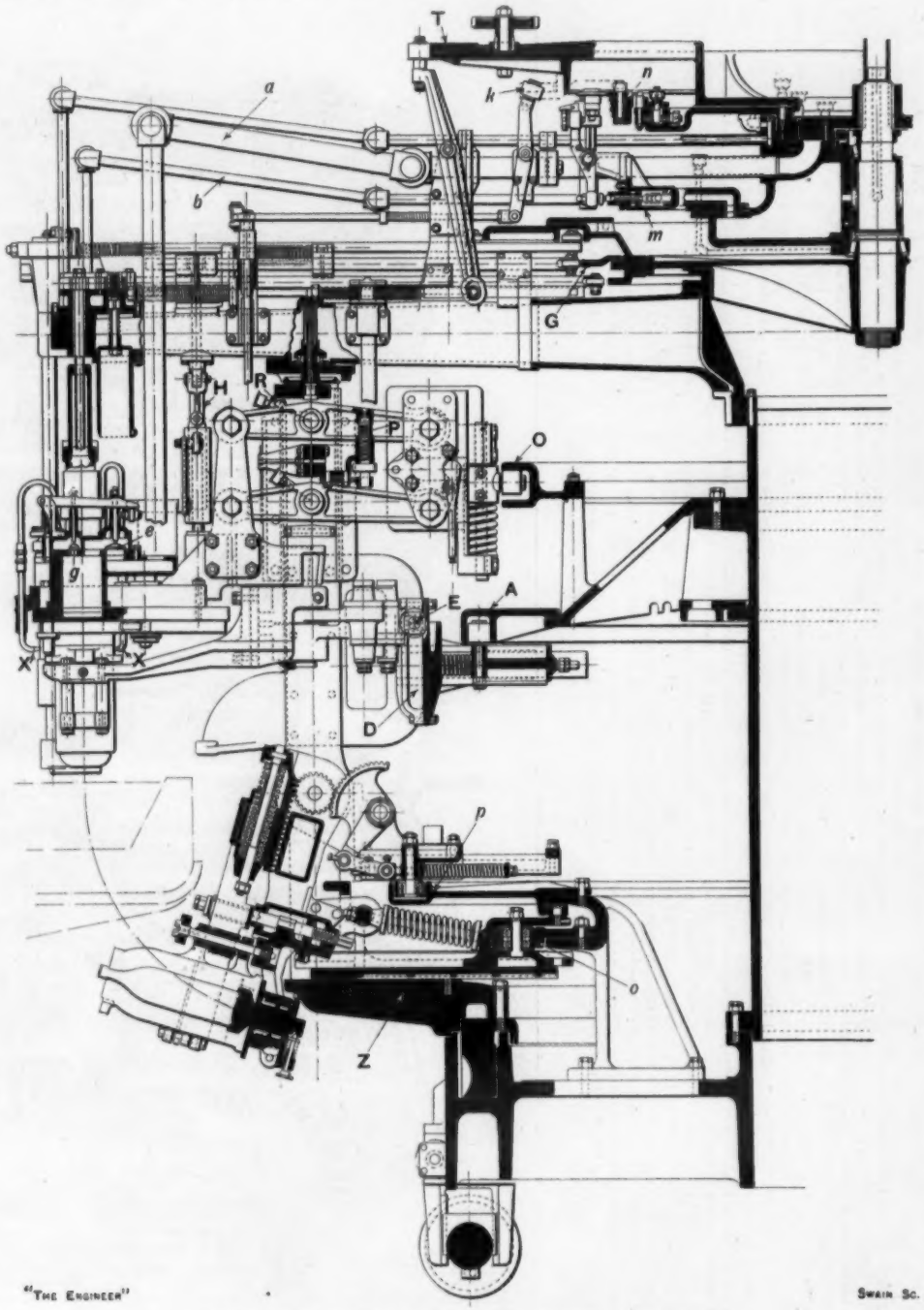


FIG. 3—CROSS SECTION THROUGH NEW FIFTEEN-ARM MACHINE

from a 15 horse-power variable speed electric motor, which enables the speed of the machine to be varied between 1½ and 6 r.p.m. The arrangement of the drive is very clearly shown in Fig. 1.

Each of the bottle-making units is built up on a hollow, inverted U-shaped frame, which stands vertically on the ring and is tied, at the top, to a central crown by a hollow radial trunk. The whole structure

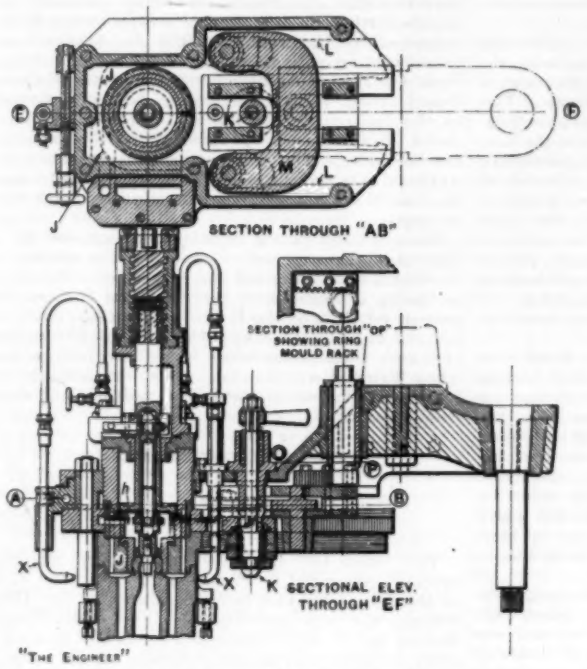


FIG. 4—CROSS-SECTION THROUGH BLOWING HEAD

thus forms a very rigid framework. The several parts are hollowed out for the passage of cooling air from the central column of the machine to the moulds and other parts subject to the heat of the molten glass.

Dealing first with the top, or blowing head, this, in its entirety, is best illustrated by the half-tone engravings—Figs 7 and 8, see page 14—which show a single complete unit, while some of its details are shown in the line drawing—Fig. 4. As shown in Figs. 8 and 9, the blowing head is in the position which it takes up over the glass pot, ready for the blank mould to be filled by suction.

The mechanism of the head may be broadly divided into five distinct sections, one for opening and closing the blank moulds, one for manipulating the neck ring moulds, the third for dipping the whole head to bring the mouth of the mould down into the glass pot, a fourth for cutting off the trailing glass, and finally one for controlling the vacuum and blowing air. Taking these sections in the same sequence, the mould-closing mechanism is similar in general principle to that adopted in the original machine, and is illustrated by Fig. 5. It is operated by the cam marked A in Figs. 8 and 5 attached to the stationary central column. With this cam there engages a roller—see Fig. 5—attached to a slide box B. This box slides within another box C, which in turn slides in the main frame of the head. The reciprocatory movement produced by the cam is transmitted from one box to the other through a pair of helical springs which are of such a strength that they will transmit the force necessary for all ordinary operation without appreciable collapse, but will give and accommodate any likely obstruction in case of accident. The principle of introducing springs in this manner is, by the way, adopted throughout the machine. At the end of the slide box C there is a vertical slot D in which a roll E can be moved. This arrangement takes the place of the pendulum used in the original machine, and is necessary, as the height of the mould, and consequently the arms carrying it, are dependent upon the length of bottle being made, while the slide boxes and roller must always meet the cam A. The roll E is fixed in a crosshead which, by means of the toggle levers shown, operates the mould arms about the pivot F. It is noteworthy in connection with this pivot, and, in fact, with all the important bearings of the machine, that they work on Timken roller bearings so arranged that they can be adjusted with the greatest nicety, not only as to tightness, but also as to position. The pivot bearings just mentioned are shown in the detail sketch on the right of Fig. 5.

Coming now to the neck ring moulds, these are situated immediately above the blank mould and form the familiar collar round the mouth of the bottle which serves to carry the blank round during the period when it is supported by neither the blank moulds nor the finishing moulds.

In the original machine the ring moulds are carried by scissor arms operated by toggle levers and a push-rod from a cam at the same level. Now, however, the cam has been raised to the position shown at G—Figs. 9 and 3—and a more substantial style of mechanism, indicated in Fig. 4, has been adopted. This mechanism is operated through a rack and pinion and a vertical spindle H in Figs. 8 and 9. Referring to Fig. 4, it will be seen that the ring moulds JJ swing about the vertical pivot K, and have rearward extensions L L shown by dotted lines in the plan view. In the outsides of these extensions it will be seen there are notches with sloping edges towards the front and abrupt shoulders at the rear. In these two notches there slide two rollers fixed in the yoke-shaped frame M. By pushing this frame forward, the rollers, sliding

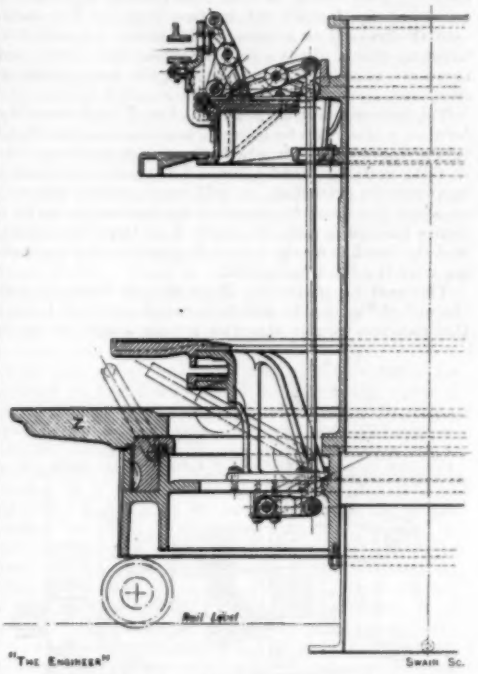


FIG. 6—FOUNDATION RING AND CENTRAL COLUMN

up the slopes, will close the ring moulds together gently but firmly, while on the return stroke the rollers meet the shoulders and open the moulds abruptly. The yoke is reciprocated by a rack and a pinion on the bottom end of the spindle H—Figs. 8 and 9. The spindle, in turn, is rotated by the rack and pinion N on the end of a push rod worked by the cam G.

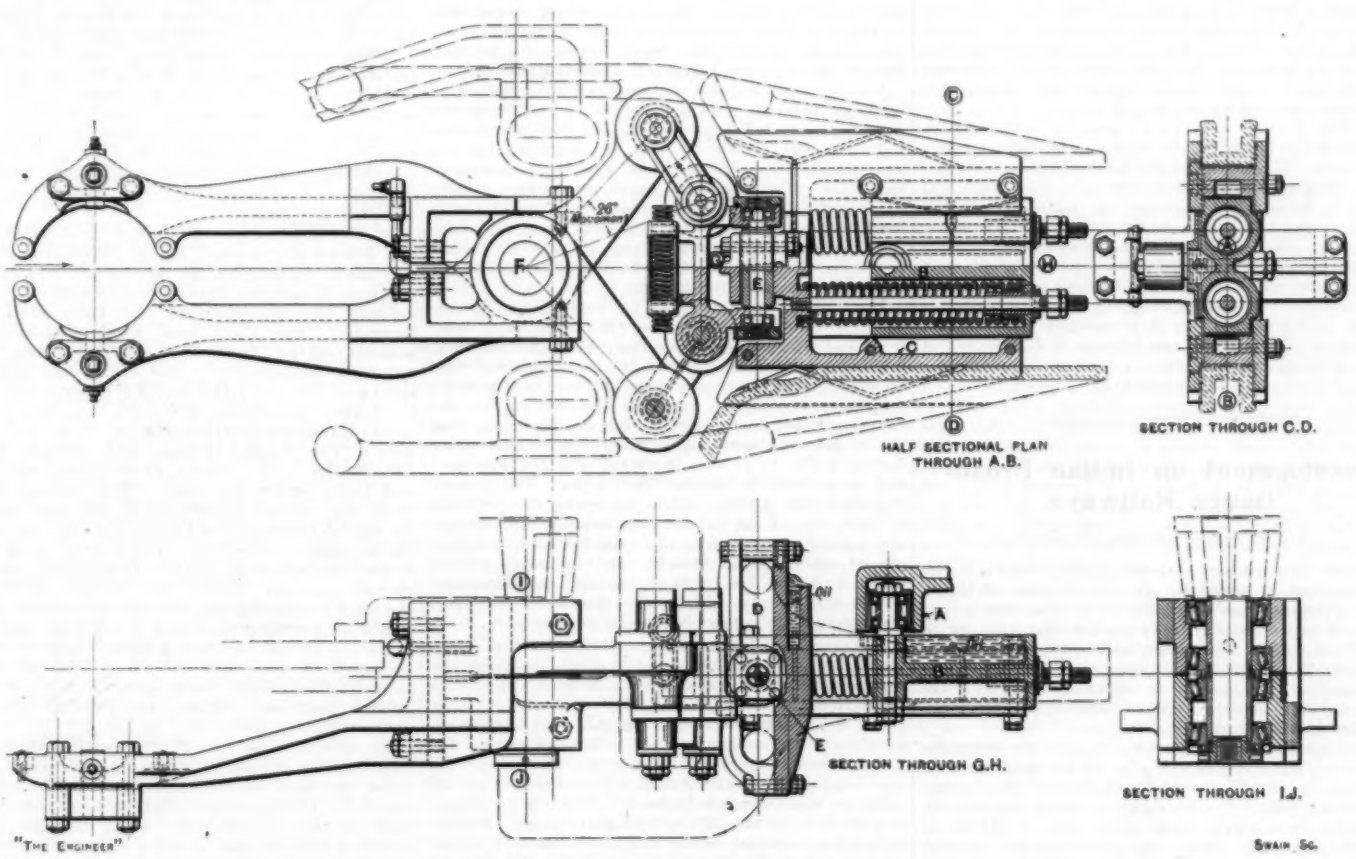


FIG. 5—MECHANISM FOR OPERATING BLANK MOULDS

Accommodation for the rise and fall of the head is provided by a telescopic sleeve on the vertical spindle.

The rise and fall of the head, for the purpose of dipping the mould into the glass, is effected in a very similar manner as before, but with an extra movement. The head is mounted on the two parallel levers—see Fig. 3—which carry a counter-balance at the back, and the dipping is effected by the direct engagement of a roller on the back of the weight with the

cam O—Fig. 9. So far the arrangement is not novel, but an extra movement has been added for the following reason. When the trailing glass is cut off, after the blank mould has been filled, the knife must be held beneath the mould for a short time to prevent the glass running out again, but on the return stroke it should not rub across the newly cut face or an arris will be formed, which will deface the bottom of the bottle. The lifting of the head, after dipping, is consequently carried out in two stages. The main cam O effects both stages, by lowering the counterweight, which always overbalances the head, but there are two stops against which the head abuts in succession.

The first stop is shown at P in Fig. 7, and takes the form of a steep-pitched screw, working in a nut fixed to the framework, on which the upper lever rests as it falls and the head rises. This screw stop can, however, be retracted, as will be described directly, to allow the lever to continue its movement until it meets the solid stop R, when it is truly horizontal and the head is firmly set, as to position, for registering with the finishing mould.

The working of the stop P can best be followed with the aid of Fig. 8. It will be noticed that just behind the balance weight there is a long pinion S—it is

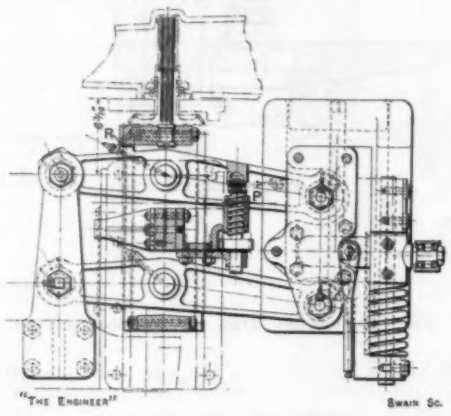


FIG. 7—BLOWING-HEAD STOPS

long to accommodate the adjustment of the head to suit the size of bottle being made—on a spindle, at the top of which there is a rack and pinion, while the rack is worked by a rocking lever from the overhead cam T. The long pinion S meshes with a wheel on the screw stop P, Fig. 7, and consequently the rise of the head can be controlled by the formation of the cam T in any desired fashion until the head is definitely checked by the stop R.

In Fig. 7 there can also be seen the gear used for adjusting the height of the head to suit different sizes of moulds. The whole parallel lever system is mounted in a frame which can slide vertically in the main U frame of the unit and is carried by a buttress threaded screw at the top. This screw works in conjunction with a nut, carried by ball thrust bearings, which has a mitre wheel for engaging with another wheel on a hand wheel spindle. The hand wheel is arranged in a convenient position for reaching from the platform, which will be erected round the machine at about the ring level. This wheel can be seen in Fig. 9 just in front of the parallel levers.

(To be continued.)

Development on Indian Broad-Gauge Railways.

(By an Indian Railway Engineer.)

MORE than ordinary interest centres round a publication recently issued by the Government of India, in the shape of revised rules to be observed in the preparation of railway projects for that country in the future. The recommendations for broad-gauge railways to be built to serve intensive mineral districts forecast a development in carrying capacity, size and tonnage which should make even American experts in transportation envious.

The advisors of the Railway Board are evidently intent on removing any stigma which may exist regarding the carrying capacity of the 5ft. 6in. gauge, and consequently recommend a track suitable for carrying 28-ton axle loads, with rails of 110 lb. or 115 lb. per yard. To operate on this track, locomotives, which will make the present "mammoths" of America look like "dwarfs," are hinted at. A loading gauge of 16ft. high and 12ft. wide will provide for carriages of huge dimensions, and will make possible the use of wagons capable of conveying 120-130 tons of mineral.

It is true that no particular line is indicated for these colossal dimensions other than they are to apply generally to any railway which may be conceived in the future for the development of considerable mineral traffic. It is clear, from a perusal of the orders, that they can only be applied to a railway entirely traversing a "black country" district, linking up the source of supply of minerals with the industrial centre where the raw materials are utilised, or for some direct line of transport for coal, or ore, from the mines to a port from which the material is to be shipped for export. Any railway forming a link between sections of the present system is out of the question, for the large bulk of the consignments would only create great and objectionable congestion at the interchange junctions with the railways of less carrying capacity; the troubles arising would be tantamount to those experienced with a change of gauge.

We assume that, however limited the application of these revised rules may be in the first instance, the framers have in view the ultimate reconditioning of existing lines up to the revised standards. This being so, we venture to ask, If the design of rolling-stock to meet such requirements has been really considered? and, If it has, What are the deductions arrived at regarding its comparative efficiency in ratio of tare to load? Can wagons be built (four-wheelers) to carry, say, 40 tons of coal, with a less tare than 15 or 16 tons? If not, then, what is to be gained in adopting, certainly more inconvenient units, simply to pile up the axle-load, necessitating stronger bridges, heavier rails, &c.—leaving out all other details required for handling the wagons, hoists, transhipment ferries, &c.

A speaker at a recent meeting of the Institution of Locomotive Engineers, when debating this question of ratio between tare and load, "pictured cars for such dimensions with a row of columns down the centre to support the roof, and axles similar to 100-ton guns." Will not the increased tare more than discount any gains to be secured from such ultra-concentrated loads? At present wagons are made for the Indian broad-gauge railways which can carry 23 tons with a tare of 9 tons and an axle-load limit of 16 tons. It is extremely difficult to beat this to any appreciable extent.

We fear that no doctoring of the 5ft. 6in. gauge will really correct its deficiencies. We have heard that when the present Virginian Railroad in America was first projected the promoters had a vision of a railway with a gauge of track of no less than 10ft., but before any commencement in construction was made a committee of engineers was appointed to investigate and report. The unanimous opinion of these experts was that a gauge of not more than 5ft. would give the most profitable ratio between tare and load, and would be best as far as cost of construction was concerned. As all the connecting lines were 4ft. 8½in.—the standard gauge of the country—that dimension was adopted for the Virginian lines, which carry, we believe, the heaviest consignments of coal of any railway in the world. This is interesting, as pointing to the fact that in railways, as in nearly all other engineering propositions, there appear to be well defined media beyond which it is undesirable to go.

For locomotives built on orthodox lines, with axle loads of 28 tons, it is not difficult to estimate the possibilities. A "decapod" 2–10–2 with a draw-bar pull of some 75,000 lb. can be imagined, but we would ask, if it is not possible, with the present-day development of articulated types, to produce a locomotive of similar or even higher efficiency with axle loads not exceeding 18 tons, thus obviating the additional outlay on permanent way of from £500–£600 per mile, leaving out other considerable extras required for stronger bridges, &c.

Regarding passenger stock for such liberal dimensions, we are aware that cars 12ft. wide have been built and are running on the Bombay electrified lines, but the service is exceptional, the requirements being to accommodate the largest possible number of persons per train at certain hours of the day. For the ordinary main line passenger service, however, with the interiors of the carriages arranged in the customary Indian style, it is very doubtful whether any gain will be secured by making them wider. The present overall width of 10ft., which can readily be stretched to 10ft. 6in. if all outstanding handles and fittings are included, provides ample space for compartments placed either longitudinally or crosswise, with a corridor of from 2ft. to 2ft. 6in. wide; any additional width will simply add to the deadweight without conferring any counter-balancing advantages.

Experience in India had proved that for the broad-gauge railways four-wheeled wagons provide the best ratio between tare and load, until vehicles of more than 50 tons capacity are required. At that point it is possible to build wagons with a more remunerative ratio, but only to a limited extent, for after certain recognised dimensions are passed the tare begins to increase to such a degree that expected gains are more than neutralised. That a bogie wagon can be built for the 5ft. 6in. gauge to carry 120 tons with a less tare than 48 tons is open to doubt; it would require six-wheeled bogies to get the distribution of weight inside the permissible 28 tons per axle. American coal wagons of 120 (short) tons (about 107 long tons) capacity for the 4ft. 8½in. gauge tare about 35 long tons. It is clear, therefore, that considerable improvement will have to be made in the design and construction if a wagon of similar capacity is to be provided for the wider gauge, without seriously increasing the deadweight.

With locomotives as outlined and permissible under these revised dimensions, the loads behind the tender will be of such weight that the trains will require mechanical couplers and draught gear rivalling the strongest at present in use in America. It will be opportune, therefore, for the authorities who are at present engaged in selecting the most approved device for this purpose to bear in mind the possible requirement of increased strength and select a coupler which can be made stronger without having its contour modified—a problem specialists are already confronted with in America.

After the coupling arrangements have received consideration, the continuous brake question will require further investigation; for such trains as are suggested by the figures quoted the brakes must necessarily be of high power and quick in action. From the report, recently published by the Railway Board, giving some account of trials made last year on the Eastern Bengal Railway, there is not much doubt that unless very considerable improvement can be made in the vacuum apparatus now installed, a change over to compressed air is inevitable to meet the conditions imposed by trains of nearly half a mile in length.

Consideration of the feasibilities suggested by a perusal of these revised rules makes any opinion as to what is really intended very uncertain. One thing is clearly demonstrated, however, and that is, the present advisors of the Railway Board can never be accused of being afflicted with the want of foresight of which their predecessors have been held guilty, when laying down the many controlling restrictions for the dimensions of the Indian railways and their rolling stock.

Aircraft Carriers.

THE latest list of British and foreign warships annually presented to Parliament by the First Lord of the Admiralty, and formerly known as the Dilke Return, but now described as "Fleets (the British Empire and Foreign Countries)," indicates in a summary on page 3 that in one particular type of warship the British Navy has a substantial lead in numbers over other navies. This type is the aircraft carrier, the latest addition to fighting ships, in size approaching the capital ship, and judging from the examples now afloat, the ugliest in appearance of all types.

The summary referred to gives the number of British aircraft carriers "built" as eight, whilst Japan has four, the United States, Italy and Russia one each, and France none. Under construction the British Empire and Japan each have one, and the United States and France two each, whilst in the projected naval programmes the British Empire has one to be laid down in 1929 and Japan one in 1931.

When the details given in the body of the Return are studied, the lead of the British Empire in this type of war vessel is found to be not nearly so pronounced as the figures in the summary would indicate. Before examining these details it is instructive and interesting to notice the decisions arrived at on this type at the Washington Conference, and to trace briefly the development of vessels for the special purpose of carrying aircraft.

At the Washington Conference an aircraft carrier was defined as "a vessel of over 10,000 tons standard displacement designed for the specific and exclusive purpose of carrying aircraft and so constructed that aircraft can be launched therefrom and landed thereon." The three final words distinguish the aircraft carrier from the seaplane carrier. The standard displacement is that of the ship when fully equipped, but with the fuel and reserve feed water for boilers deducted. The total standard displacements for aircraft carriers allotted to the five nations were: The United States and British Empire, 135,000 tons each; Japan, 81,000 tons; and France and Italy, 60,000 tons each. The tonnages for the three first named Powers are in the same ratios as for capital ships, but for France and Italy are greater, the tonnage corresponding to such ratios being 45,000. It was also agreed by the five Powers that individual aircraft carriers should not exceed 27,000 tons standard displacement; should not mount guns of a calibre exceeding 8in.; and if any guns exceed 6in. calibre, the total number of guns, exclusive of anti-aircraft and guns not exceeding 5in., should not exceed ten; whilst if the armament included no gun greater than 6in. calibre, the number should be unlimited.

An exception to the 27,000 tons maximum unit displacement was agreed to in the decision that provided the total allotted tonnage was not exceeded, any of the Powers might build not more than two aircraft carriers, or might convert to the same purpose not more than two capital ships which were either completed or under construction, and which by other provisions of the agreement would be scrapped, but the maximum standard tonnage in either case should not exceed 33,000. It was further agreed that if the standard tonnage of any such vessels exceeded 27,000, the total number of guns, if any exceeded 6in. calibre, and exclusive of anti-aircraft and guns of 5in. and below, should not exceed eight. In accordance with this provision of the agreement the United States decided to convert the Saratoga and Lexington, two battle-cruisers of their 1916 programme, laid down in 1920 and 1921 respectively, and which with their four sister vessels would have been scrapped. Japan

also decided later to convert to aircraft carriers the battle-cruisers Akagi and Amagi, laid down in 1920. The Amagi was severely damaged in the great earthquake four years ago and was replaced for conversion by the battleship Kaga, laid down in 1920. As originally designed these American and Japanese ships displaced over 40,000 tons.

It is noteworthy that although at the time of the Washington Conference the British Empire was the only Power whose Navy had any extended experience with this new type of war vessel, yet as complete an agreement was reached in regard to it as for the capital ship, a type whose design, construction, and operation were familiar to all the Powers concerned, and had almost become standardised.

Development of Naval Flight.

The evolution of the aeroplane during the sixteen years which had elapsed since the Wright Brothers made their first public flight in October, 1905, had been very rapid, and the value of aircraft in land and sea operations had been fully established. In comparison the development of the aircraft carrier had been extremely slow, a reflection of the difficulty of the problems which attend the successful operation of aircraft on shipboard. The significance of the Wrights' first flights was not fully appreciated by the United States naval authorities, and it was not until shortly after their further flights at Fort Myer, Virginia, in October, 1908, that United States naval officers were detailed to undergo flying instruction, and investigate the use and value of the aeroplane for naval purposes. Flights had been made in the interval by Santos Dumont and Farman in France, and the naval authorities of other nations had become interested in aviation.

Two years later, November 14th, 1910, an aeroplane was successfully flown from the United States cruiser Birmingham whilst at anchor, an inclined platform erected over the forecastle giving the necessary length of run for taking off. On January 18th, 1911, a successful landing was effected on a platform erected over the quarterdeck of the United States battleship Pennsylvania whilst at anchor, a most difficult operation, in which the aeroplane was gradually brought to rest by engaging with a number of wires stretching across the platform at right angles to the line of flight. The wires passed around sheaves at the edges of the platform and were kept taut by bags of sand suspended by the wires over the ship's sides. The aeroplane was flown off the platorm the same day, showing it had suffered no material damage on landing. In 1911 and 1912 flights from light sloping platforms temporarily erected over the forward turrets and guns of the British battleships Africa, Hibernia and London, and over the forward deck of the cruiser Hermes, were made by Commander Samson, some of the flights being from the ships at anchor and others when under weigh. The more difficult feat of landing on the vessels does not appear to have been attempted.

Experience in these tests showed clearly that if the flight of aircraft from warships became a necessary operation, various additions, not however of a very substantial character, above the forward weather deck would be required, and these would interfere to a greater or less degree with other important features of the vessel, *i.e.*, the training and fire of the guns, &c. But these additions and the interference they caused appeared far less extensive and serious than those entailed in providing facilities for the reverse operation of landing aircraft in flight on a ship. For such a purpose, experience in aerodromes pointed to the necessity of a long and broad deck free from all obstructions. Such a deck combined with a relatively high speed of vessel, thus virtually increasing the length of the deck, would considerably facilitate the operation of landing on, the ship streaming into the wind and the aeroplane flying in the same direction. Although high speed was a feature of several classes of warships at the time, none of these possessed anything approaching the necessary areas of clear deck. A new type of vessel for the operation of aircraft at sea was already clearly foreshadowed.

At this stage attention was diverted to the seaplane, a type of aircraft which had been developed by Curtiss in America, and by others elsewhere, and which by its ability to fly from and alight on the sea and remain afloat, offered a simple alternative to the building of fast vessels with extensive platforms or decks for receiving the ordinary type of aeroplane when it attempted to land. Seaplanes could be arranged to fly off the forward weather-deck of a ship with some slight additions and modifications, and on returning from its flight could alight on the sea on the lee-side of the vessel, and be hoisted on board by a crane. For the latter operation the ship had to be stopped, but this disadvantage was accepted, the danger from hostile submarines whilst the vessel was hove to not being appreciated until later. Early in 1914 the British Admiralty purchased a vessel then under construction and directed her conversion to an aircraft carrier. Designed as a tramp steamer with a speed of 11 knots, various alterations had to be made to render her suitable for her new service. The engine and boilers were placed aft to give a good length of clear weather deck forward for flying off and to provide an adequate space between decks for use as a hangar. Cranes were fitted on the weather deck, one on either side, to lift aircraft from the hangar to the deck in readiness for flying off, and to hoist them from the sea when they had alighted and been brought alongside. This ship, the Ark Royal, completed in December, 1914, was the earliest representative of the aircraft carrier, a type which has now become so important. As she is not arranged for the landing on of aircraft, she is by the Washington definition not an aircraft carrier, and is designated a seaplane carrier. Later in the war several other merchant ships were purchased by the Admiralty and fitted out similarly and for the same purpose as the Ark Royal. These were generally vessels with a greatly superior speed to their prototype, amongst them being several cross-Channel steamers and the old Cunarder Campania.

The majority of these vessels were of relatively small size and stowage capacity, and although their speeds were high for merchant ships, were low compared with ordinary warships, thus preventing them accompanying the fleets in their sweeps through the North Sea. This serious limitation moved the Admiralty to the next stage of development in the decision to convert the large light cruiser Furious to an aircraft carrier, her length of 800ft., breadth of 81ft. and speed of 31 knots making her very suitable for the purpose in view. The guns and barbettes were removed and decks added forward and aft, these alterations being completed early in 1918. Aircraft from the Furious bombed the airship base at Tondern, one of the most successful raids of the war. Although valuable experience was obtained, the success of the Furious as a carrier appears to have been limited, for she was later entirely reconstructed and recommissioned in 1925. In 1916 the Admiralty decided to purchase and convert a mail steamer at Messrs. Beardmore's, which had been laid down previous to the outbreak of war and her construction suspended by it. A complete deck was fitted from end to end, and to get rid of the largest obstructions —funnels and their deck casings—horizontal ducts fitted under the flight deck led the smoke and gases from the boilers and discharged them at the stern. She was completed in September, 1918, the absence of the usual funnels, masts, &c., giving her a strange appearance of helplessness. This ship was the Argus, the first of the type of true aircraft carriers to be placed in commission, and as she has remained substantially as first completed, is evidently a success.

In 1917 the Admiralty decided to obtain other carriers. The Almirante Cochrane, a battleship under construction by Messrs. Armstrongs, for Chile, was purchased for conversion, and the Hermes, the first British vessel designed for this special purpose, was ordered to be built to Admiralty plans by the same firm. The ex-battleship, re-named Eagle, was commissioned in 1920, but after undergoing various trials with aircraft, it was decided to effect considerable modifications in her arrangements. This work was carried out at Portsmouth, and she was recommissioned in 1924. The Hermes, after launching, was transferred to Devonport, being completed there in 1924.

The United States Navy Authorities decided in 1921 to convert the collier Jupiter to an aircraft carrier, the work being finished in 1922, and the vessel re-named the Langley. The Hosho, of the Japanese Navy, designed like the Hermes as an aircraft carrier, was laid down in 1920 and completed in 1922. The Fleet Return also mentions a Japanese carrier, the Notoro, formerly an oiler, as being converted in 1922, but no trace of this vessel for such a service is found in the usual books of reference. When the representatives of the Naval Powers met at Washington in 1921 there was thus only one of the true aircraft carrier type in service, the Argus, which had been completed three years, whilst the Langley and Hosho were approaching completion.

Air-craft Carriers of the World.

The present position of the type in the various navies is indicated by the details of the Fleet Return. The eight aircraft carriers of the British Navy classed in the summary as "built," are Courageous, Glorious, Hermes, Eagle, Furious, Argus, Pegasus and Ark Royal. The last two are stated to be seaplane carriers, their displacements being respectively 3070 and 7080 tons. The Courageous and Glorious are each described as "being converted into an aircraft carrier," the First Lord's statement on the Navy Estimates giving their completion as the present financial year and 1929 respectively. There are thus four British vessels of the aircraft carrier type completed and in commission in place of the eight which might be assumed from the summary. The tonnage of the Furious as a cruiser was 19,000, the Return gives it as 22,450, which is presumably her standard displacement. Taking the tonnages of the other three to be similiarly expressed, the total is 70,000, or slightly more than one-half that allowed by the Washington Agreement. If the tonnage of the Courageous and Glorious as aircraft carriers is the same as of Furious, their completion will increase the total to 115,000 tons, or 20,000 tons less than the 135,000 allowed. The tonnage of the Albatross building in Australia for the Commonwealth Navy is not stated in the Return, but she is described in a note as a seaplane carrier, and thus falls outside the total allotted tonnage for the British Empire.

The Lexington and Saratoga are, according to reports in the American Press, to be shortly completed, and as their tonnages are given as 33,000 tons each and that of the Langley as 12,700, the total aircraft carrier tonnage of the United States Navy later in the year will be about 79,000, or 58 per cent. of the total allowed. Japan, according to the Return, has four aircraft carriers built, the Akagi, Hosho, Notoro and Wakamuja, the displacements of the Hosho and Wakamuja being 9500 and 5875 tons respectively, placing them outside the total of allotted tonnage. As already mentioned there is a doubt as to the Notoro of 15,400 tons being an aircraft carrier, but if she is included with the Akagi of 26,600, the aircraft carrier tonnage built and reckoned in the Washington Agreement total is 42,000, which, with the Kaga completed, will be raised to 69,000, or 12,000 tons less than the total allowed.

France is converting the battleship Bearn, launched in 1920, to a carrier, her tonnage being given as 21,160. A second vessel, the Commandant Teste, described as an aviation transport, of 10,000 tons and 21 knots, is under construction. It is reported that she is to be fitted with two catapults, and is presumably a seaplane carrier. Italy is credited with only one aircraft carrier, the Miraglia, a converted merchant ship, of 5000 tons and 22 knots, completed in 1925. Russia has also one, the Orlitza, of 3000 tons and 10 knots speed.

The maximum speeds of the various vessels are included in the Return, the highest being those of the Lexington and Saratoga, with 33 to 34 knots, followed by the Furious, Glorious and Courageous with 31, Akagi 28·5, Hosho and Hermes 25, Eagle 24, Kaga 23, Miraglia 22, Bearn 21·6, Argus 20 to 21, Langley 14·5, and Notoro 12. Speed is obviously an important quality in an aircraft carrier, as in the absence of wind, both flying off and landing on must be rendered easier the higher the speed of the vessel. One interesting particular is omitted from the Return, and that is the number of aircraft carried by the various vessels. From other sources it is learned that the Lexington and Saratoga are to carry 72 to 80 planes each, the Akagi 50, and the Bearn 40, whilst it is stated that the Langley carries 34 and can stow 55, and the Argus and Hermes 20 each. The United States Press also states that the two American carriers are to be fitted with catapults, and with arresting gear to bring aircraft landing on the decks to rest. The nature of the latter device is not stated, but it is reported that it has been set up for trial in the aerodrome at Hampton Roads, and has successfully passed the tests to which it was subjected. Arresting gear appears to be a necessity in all carriers, and more especially in those of low speed, but the details of the arrangements adopted by the various navies have not been published. The Langley is fitted with two catapult tracks, whose upper surfaces are flush with the flight deck, and whose lengths are respectively 145ft. and 180ft., the operating medium being compressed air. The French carrier Bearn is also to be fitted with a catapult on the flight deck forward of the funnel.

Features of Design.

An examination of the sketches, photographs and particulars of aircraft carriers which have been published at various times reveals many differences in the general designs. Nearly all have a continuous flight deck extending over the whole length and breadth of the vessels, and in the Lexington and Saratoga overhanging the stem by a considerable amount. The Furious is an exception to this rule, the forward end of the flight deck being some distance from the stem, but the forward weather deck has a marked inclination, as if it might be used for flying off. The flight decks are from 40ft. to 60ft. above water, and are characterised by a broad after end, which is rounded down in profile view. The sides of the ships below the flight deck are in most instances open, giving spaces for the stowage of boats and for the guns, but in Lexington and Saratoga the side plating has been extended to the flight deck along the whole length of the vessels, apertures being cut amidships for housing the boats.

In Argus and Furious the adoption of horizontal funnel ducts under the flight deck renders the latter clear of all obstructions, but in Hermes and Eagle vertical funnels are fitted rising from funnel casings erected on the extreme starboard side of the flight deck, forming an "island." Glorious and Courageous are stated to be similar in this respect to Hermes and Eagle. In the Lexington and Saratoga the same arrangement is adopted, a huge funnel streamlined horizontally taking the place of the two with which the vessels were originally designed. The horse-power of the engines in each vessel is 180,000, the greatest in any ship yet built. The "island" in these vessels is extended by the fitting of a mast and navigating position some distance forward of the funnel casing, and by two twin turrets before the mast and two abaft the casing, all in line with the latter. In the Langley a transverse horizontal smoke duct is fitted above the boiler-room and leads on the port side into two vertical funnels, placed outside the main hull, which can be turned down fore and aft to a horizontal position well below the flight deck level when flying is in progress, whilst on the starboard side the duct discharges through an elliptical orifice in the ship's side, a water spray playing on the discharged smoke and gases. Deflectors are fitted in the horizontal duct to guide the smoke to the port

or starboard exits, the lee side being chosen when aircraft are landing on the flight deck. In the Hosho the funnel uptakes pass out of the starboard side of the ship below the flight deck, and lead into three funnels placed outside the main hull and arranged to hinge outwards to an angle of 45 deg. when the flight deck is to be kept clear. The Akagi and Kaga are stated to be similarly fitted to Hosho so far as the funnels are concerned. The French Bearn is fitted with one funnel on the starboard side outside the main hull, but whether fitted to hinge down fore and aft as in the Langley, or outwards as in Hosho, is not stated. The "island" arrangement gives a curious and unshipshape appearance to the vessels when viewed from forward or aft, and must appreciably diminish the effective breadth of the flight deck compared with that of the clear-deck carriers.

The gun armaments as given in the Return vary considerably. The United States and Japanese naval authorities have taken full advantage of the provisions of the Washington agreement and adopted guns of 8in. calibre to the full number allowed. The Lexington and Saratoga are to carry eight of these guns in four twin turrets placed in pairs in front of and abaft the "island" on the flight deck, with the guns of one turret of each pair firing over the other. As an anti-aircraft armament each vessel mounts twelve 5in. guns, placed in groups of three on each quarter, the bases of the mountings standing on the deck next below the flight deck, vertical fire being provided for by cutting embrasures in the latter over the gun positions. The Akagi, according to the Return, is to carry ten 8in., four 4·7in., and twelve 4·7 A.A. guns, but their disposition on the ship has not been published. The Kaga's armament is not given in the Return, but is probably the same as Akagi's, which is evidently based on that of the American vessels. The Hosho mounts four 5·5in. and two 3in. A.A. guns. The armaments of the British carriers vary, but all appear weak compared with those of the latest American and Japanese ships. The Eagle mounts nine 6in., five 4in. A.A., and eighteen smaller guns; the Furious ten 5·5in., six 4in. A.A. and eighteen smaller; the Hermes seven 5·5in., three 4in. A.A., and twenty smaller; the Argus six 4in. A.A. and eighteen smaller; whilst the Courageous and Glorious are each to carry eighteen 4·7in. and eighteen smaller guns. The French carrier Bearn has an armament of eight 6·1in. and six 3·9in. A.A., and the Italian Miraglia is stated to carry six 3in. or 4in. A.A. guns. None of the British carriers is fitted with torpedo tubes, but the Lexington and Saratoga have each twelve tubes, and the Akagi and Bearn six each.

CONCLUSION.

The particulars outlined in the foregoing remarks show that the completed tonnage of aircraft carriers is rapidly increasing, but that the type has not yet approached a standard size and form, as in the older classes of warships, whose representatives in the various navies are not greatly different. This may be explained partly by lack of experience in the operation of aircraft on shipboard, but to a much greater degree by economical reasons which have necessitated the conversion to aircraft carriers of large vessels designed for other purposes. Already in America criticism has been directed against the great size and cost—forty-five million dollars each—of the Lexington and Saratoga, and it has been suggested that for various reasons vessels of about one-third their size would have been preferable. In 1924 a Committee appointed by the President recommended the construction of a 23,000-ton aircraft carrier, but the President vetoed the proposal, preferring to await experience with the two larger vessels. France—usually a pioneer in the development of new warship types—and Italy have made little progress in the aircraft carrier type and are probably watching the efforts of other Powers. Naval experts of both nations have advocated the construction of vessels for the purpose of less than the 10,000-ton standard displacement, which in consequence would fall outside the allowed Washington tonnage. For many reasons the particulars of future designs of aircraft carrier will be studied with interest by naval experts.

Newcomen Society: Summer Meeting.

"WHAT a wonderful old place London really is," was the exclamation of one of those who took part in the Summer Meeting of the Newcomen Society for the Study of the History of Engineering and Technology, when the three-day meeting came to an end on Saturday, June 18th. The remark was justified, when we mention that one of the crafts that were seen is 4500 years old, carried on in essence practically unchanged all through those centuries, and another has been pursued uninterruptedly at the same spot since the days of Good Queen Bess.

THURSDAY'S VISITS.

The Thursday morning was devoted to the Operative Department of the Royal Mint, by kind permission of the Deputy Master, Colonel R. H. Johnson, C.B.E. The members, of course, did not find the staff clad in costumes of the Tudor period, and heftily engaged in making "hammered" money, as they might have been led to expect from what they saw at the Mint exhibit at Wembley, but they were surprised at the extent of the modern plant; practically all the early machinery has been scrapped, and not even one of the coining presses introduced by Matthew Boulton when he reorganised the coining department in 1808-10 is left. Possibly the pantographic die-sinking machine by which the master die is prepared from the artist's large-scale model excited most interest. In essence the machine is the French *tour à portrait* of the eighteenth century, but with the improvements of the spiral motion and automatic cone pulleys for the feed, revolving tool, &c. The sharpening of the latter for an unbroken campaign of perhaps fifty hours finishing cut was realised to be no small task. Bronze and nickel only were being coined, much to the regret of the party. The processes of milling, ingot casting, rolling, annealing, blanking, coining, sorting, acid cleaning, and washing, drying, examining, weighing and bagging were followed with close interest. The plant is not fully employed unfortunately, and it was sad to see a roomful of Cotton's ingenious coin weighing and sorting machines for gold and silver lying idle. The visit terminated with a graceful little presentation to Mr. H. Phelps, who had arranged all the details of the visit.

The afternoon was devoted to a visit to Bryant and May's match factory at Bow, the intention being to mark the centenary of the discovery of the friction match by a tour of the remarkable museum of fire-making appliances brought together recently. By the courtesy of the directors, the visit was extended to cover an inspection of match-making as carried on at the present day, with the notable concomitant provision of welfare accommodation for the staff in the way of canteens, men's and women's clubs, concert halls and gymnasia. Commencing in the yards, the members saw the rough aspen or pine logs brought in on trollies, cut to length by a circular swing saw, and barked. The longer lengths were skived by veneer-cutting machines into the material for match boxes. The automatic machines for making these was followed with great interest, as well as the beautiful little rotary colour printing machines for producing the labels and the wrapping papers, but most admiration was reserved for the automatic machines for making Swan vestas and safety matches from the raw wood to the finished article ready boxed for use.

Tea was thoughtfully provided for the party by the directors, in the staff dining-room, and a move was then made to the well-lighted museum, where Mr. Miller Christy, who was responsible for the arrangement of this unique collection of fire-making appliances, gave a rapid survey, illustrated by the examples before him, of the art of making fire, which, after food and clothing, is an essential of the human animal. The documentary matter establishing the sale of the first friction matches just a century ago attracted perhaps most attention.

The party then drove out by a circuitous route, permitting a peep at the beauties of Waltham Abbey Church, to Buckhurst Hill, where at the "Roebuck" the annual dinner was taken.

FRIDAY'S VISITS.

Friday morning was devoted to visits to the gold-beating works of Messrs Geo. M. Whiley, in Whitfield-street, established 1783, and to the bookbinding establishment of Messrs. Robert Rivière and Co., in Heddon-street, W., of equally old standing. At the former place a handicraft as old as the Pharaohs is carried on. Except that the gold is beaten thinner by the aid of goldbeaters' skin, and the hammer is of steel instead of stone, the technique remains the same. Machinery is only used for rolling out the "ribbon" from the ingot, and for the first stage of beating. The beating is done on solid blocks of marble, which with many of the hammers are centuries old. The last stage of beating is the crucial one, and out of five apprentices taken from school only one is expected to attain to this final proficiency. The trimming and making up the gold leaf into books is done by female labour. The malleability of gold is extraordinary, 1 oz. being capable of covering 250 square feet.

The bookbinding establishment was fascinating too, because here the party was shown the process of rehabilitation of an old book—bleaching, grafting in new paper to replace any torn away, sizing and toning to the mellowness of age. The binding and tooling—almost entirely handicraft and the self-expression of the binder—were quite a joy.

The afternoon was given up to a visit to the Metropolitan Water Board, by kind permission of Mr. H. E. Stilgoe, M. Inst. C.E., chief engineer. Starting at the head offices, Clerkenwell, it was pointed out that these occupy the site of Sir Hugh Myddelton's "New River Head" of 1613. The oak withdrawing-room, taken out of the old offices and reinstated here, was greatly admired. Many objects of interest, such as old wooden water pipes, were seen in the corridors. Outside the round-house, formerly accommodating a windmill for pumping, parts of the Newcomen engine-house of 1767 that replaced it and the present engine-house built for a Boulton and Watt engine, were pointed out. The old "Devil's Conduit," formerly in Queen's-square, Bloomsbury, and re-erected here as recently as last year, afforded an idea of what constituted water supply before the advent of the New River.

The visit, however, could not be protracted, as the Kew Bridge station, where are the oldest engines in regular work possessed by the Board, was yet to be visited. Here are two Boulton and Watt engines of 1820, a Cornish engine of 1836 by Maudslay, Sons and Field, two other Cornish engines of later date, and a "Bull" engine by Harvey and Co., of Hayle Foundry. What memories the latter brought up of the stern lawsuit between James Watt and Edward Bull for infringement of the former's patent! We were told that these engines have to go, but when we learnt that the power of the largest—100in. cylinder and a veritable megatherium among engines—was only 200 H.P., one realised that nothing can save them; but "there were giants in those days" when they were built.

A stroll and tea in Kew Gardens were judged to be the appropriate ending to this well-filled day.

SATURDAY'S VISIT.

The best of all the visits was perhaps that, on Saturday, to the Whitechapel Bell Foundry of Messrs. Mears and Stainbank, a firm which has perhaps been longer established in one place than any other in Britain, *i.e.*, since A.D. 1570. The manager, Mr. Hughes, conducted the party, unfolding the history of bells, of bell founding and of bell-frames at each successive step. Again it was a story of handicraft and of family skill, even unto the eighth generation. The shape and proportion of the bell to obtain the best tone, bell metal, the founding and casting, the tuning and the correct hanging of the bell were all illustrated by examples passing through the shops. Yet technique advances, and we learnt that ball bearings are now always fitted to the gudgeons of the mountings. Hand bells are also made, and it was a treat to find an old wooden lathe at least 200 years old which is still in use for turning and tuning by hand tools. It had been originally hand driven by a pulley and belt, then it had been connected up with the old steam engine; when that departed it was coupled to an electric motor and there is every appearance that it will still be going strong when "juice" from Sir Oliver Lodge's atomic energy power station can be delivered to it in the distant future.

NEW BRITISH STANDARD SPECIFICATIONS.

INSULATING OILS.

A specification, just issued by the British Engineering Standards Association, is a revision of No. 148, 1923, which was a tentative specification for oils for use in transformers, oil switches and circuit-breakers. The latter has been very extensively used, and as the result of over three years' experience in working with it various amendments have been found desirable, these being chiefly directed towards increasing the available sources of supply of suitable oils and also towards extending the scope of the specification to cover oils for all electrical insulating purposes with the exception of oils for use in cables.

The classification of the oils in the new specification is based, as in the old specification, on the sludging properties of the oils, but Class C oil has been eliminated. Each class of oil is further subdivided, for classification purposes, into three grades, these grades being based on the "cold test" of the oils. The oils are no longer graded according to the viscosity, only one viscosity limit being given in the new specification for all classes. The methods of carrying out the various tests called for by the specification are very fully described in the Appendices, the test for determining the sludge value of the oil having received special attention. Since the issue of the tentative specification in 1923 a considerable amount of research work has been carried out in connection with the tests on oils, and the experience gained in this work has been reflected in the descriptions of the methods of carrying out the tests which have been employed.

It should be added that the preparation of this revised specification has been undertaken with full knowledge of the progress of the deliberations of the International Electrotechnical Commission, which body is carrying out extensive tests with a view to the ultimate preparation of an international specification for tests on insulating oils. Copies of the new Specification (No. 148, 1927) may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

RIVETS.

THE Association has also published Specification No. 275, 1927, for the Dimensions of Rivets. This specification, which is intended to meet the requirements of structural work—other than boilers—gives the standard diameters for rivets from ¼in. to 1¼in. inclusive, the manufacturing tolerances on the shanks, and the standard proportions for snap, pan, and countersunk rivet heads. For the sake of clearness, sketches are included in the specification showing how the tolerances are disposed in the case of:—(*a*) Rivets up to 5 diameters long; and (*b*) rivets of greater length.

The material for steel rivet bars has already been standardised by the Association in the British Standard Specification dealing with structural steel for shipbuilding, railway rolling stock, and bridges and general building construction. This specification takes the place of Appendix 7, which it was proposed to issue in connection with B.S. Specification No. 153, parts 1 and 2, 1922, for girder bridges. Copies of this specification may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, S.W. 1. Price 2s. 2d. post free.

G.W.R. New Four-cylinder Express Locomotive.

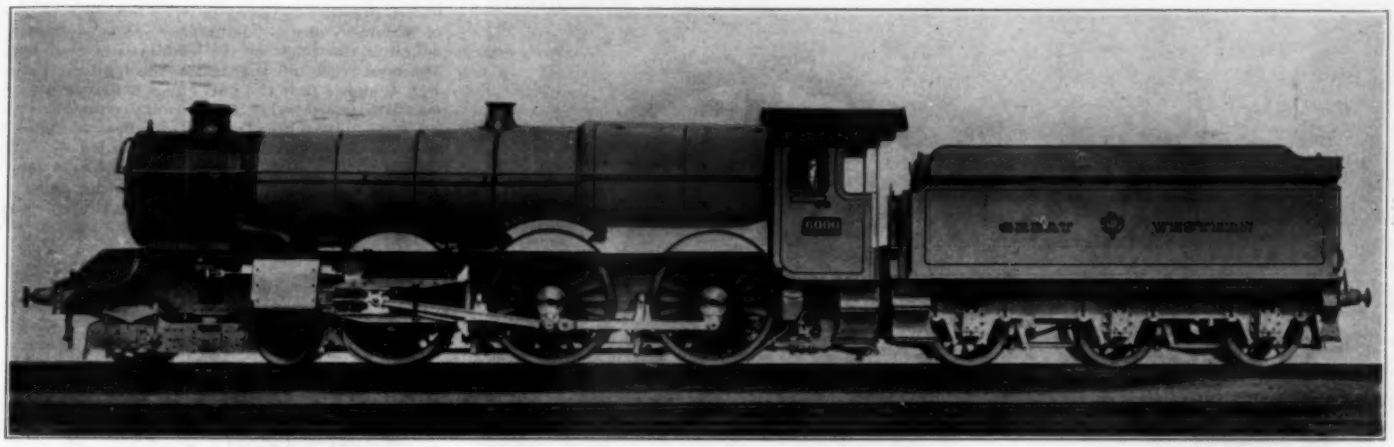
WE have just had an opportunity of inspecting one of the latest locomotives built by the Great Western Railway at Swindon. This engine, which is numbered 6000, is one of twenty now going through the shops, and is illustrated by the accompanying half-tone engravings, while the line diagram gives the distribution of the weights. It is noteworthy through having the greatest tractive effort of any express locomotive in Great Britain, the draw-bar pull being 40,300 lb. at 85 per cent. of the boiler pressure. Incidentally, the steam pressure is higher than general practice, being 250 lb. per square inch.

As will be seen from the illustrations, the engine is of the standard Great Western 4–6–0 type, with four cylinders. The inside cylinders are set well forward under the smoke-box, and work the front driving axle, while the outside cylinders drive the centre wheels. All three axles are, of course, coupled. In fact, the engine might be described as a larger edition of the "Castle" class of the same company, except that the driving wheels have been made slightly smaller in order to get a good acceleration at starting.

The total adhesion weight amounts to 67 tons 10 cwt., and is divided equally between the three axles by equalising levers, so that each wheel bears 11 tons 5 cwt. The bogie is spring controlled and is of unusual design, as

G.W.R. FOUR-CYLINDER EXPRESS LOCOMOTIVE

MR. C. B. COLLETT, M. INST. C.E., SWINDON, ENGINEER



the leading axle has outside bearings, while its trailing axle is fitted with inside bearings. This arrangement has been adopted as the rear wheels are tucked away inside the outside cylinders, and there is consequently no room for outside axle-boxes. The tender is of the three-wheeled type, and is equipped with water pick-up apparatus. It weighs, when full, 46 tons 14 cwt., has a coal capacity of 6 tons, and will carry 4000 gallons of water.

The boiler is of the standard Belpaire fire-box type, but gives the impression of not having quite such a steep taper towards the smoke-box as is usual in G.W.R. engines. There is no steam dome, and the steam is taken from an open pipe at the highest point of the fire-box, whence it passes through a sixteen-unit superheater on its way to the cylinders. In this connection we noted that the regulator worked with exceptional ease with nearly a full head of steam on the boiler. The safety valve is mounted on the barrel and into its casing the feed water is introduced, so that it is pre-heated by showering down through the steam space. The inside fire-box is of copper and is supported entirely by direct steel and copper stays to the outside casing.

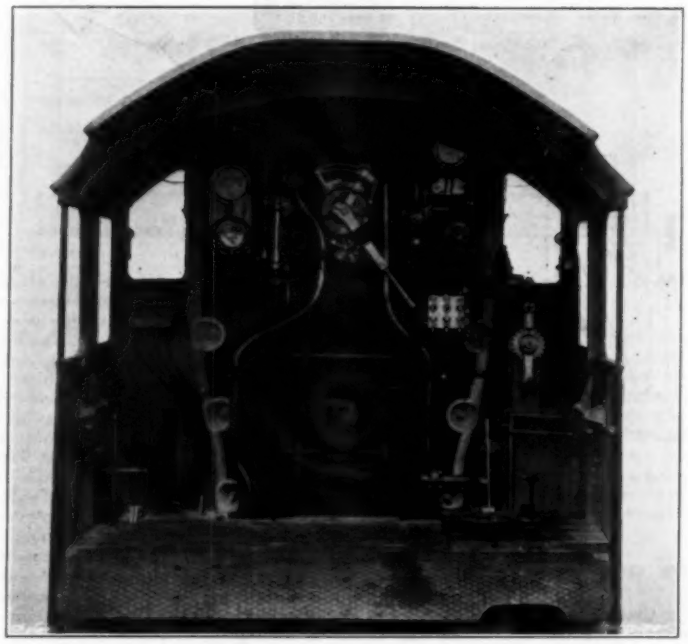
The cylinders are all the same diameter and stroke, viz., 16½in. by 28in., and are fitted with piston valves. The valve gear is of the Walschaerts type, and works the inside cylinders directly. The rods of the outside piston valves extend forward and terminate just about abreast of the rear ends of the inside rods, so that the two sets can be connected by horizontal rocking levers and work in unison. The main connecting-rods of the inside cylinders have forked big ends, fitted with gibs and cotters, while the outside rods have solid bushed ends.

The cab is exceptionally roomy, and on the occasion of our visit was not in the least overcrowded with half-a-dozen visitors and the engine crew. It is well protected by an extended roof, and the windows give the driver a good view forward, as may be judged from an inspection of our illustration of the cab. It is provided with audible signalling gear for use over sections of the line equipped with automatic train control. Vacuum brakes, equalised on all the coupled wheels, are fitted.

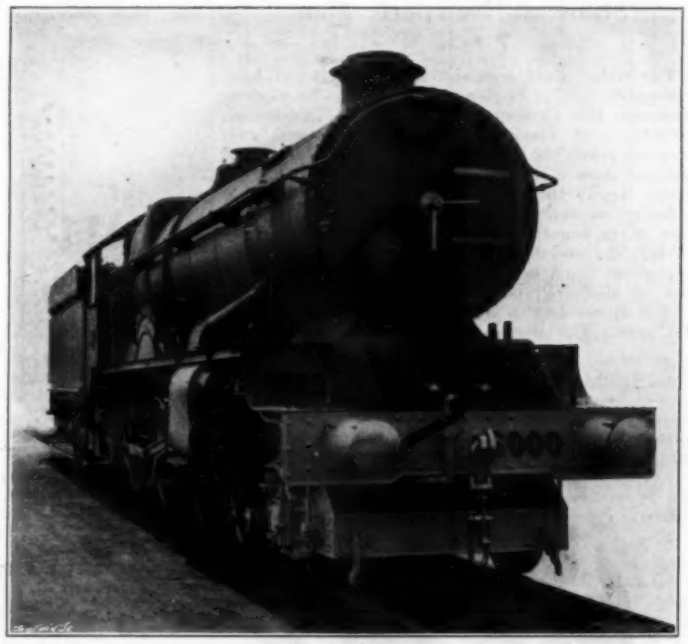
The engine is finished in the same style as that adopted for other G.W.R. express passenger engines, the chimney having a copper top, whilst the safety valve cover and cab and splasher beadings are in brass. The hand rails, &c., are polished.

The principal particulars of this new class of engine are as follows:—Cylinders, four: diameter, 16½in.; piston stroke, 28in. Wheels: Bogie, diameter, 3ft.; coupled, diameter, 6ft. 6in. Boiler pressure, 250 lb. per square inch; barrel, length, 16ft.; barrel, diameter, outside, 6ft. and 5ft. 6½in.; fire-box, length outside, 11ft. 6in.; heating surface, total, 2514·0 square feet; grate area, 34·3 square feet; tractive effort, at 85 per cent. boiler pressure, 40,300 lb.; total weight in working order, 135 tons 14 cwt.

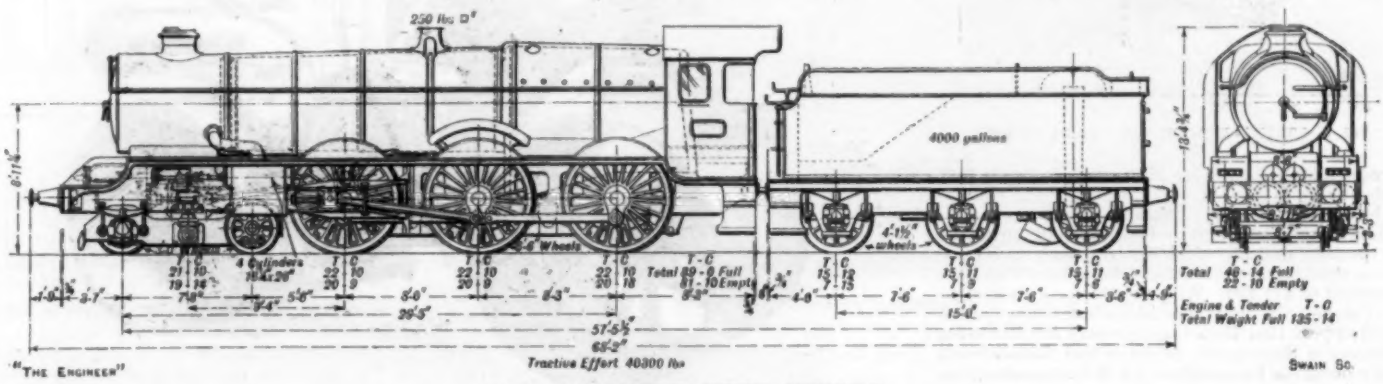
The engine has already had a number of trial runs, which have proved eminently satisfactory, and is to be put in service; but its destination, at least for some time, is Baltimore, Ohio, where it is to give some exhibition runs. In order to make it possible for the engine to work with American rolling stock, which is, of course, fitted with Westinghouse brakes, a temporary "gadget" has been fitted up in the cab, and it can just be discerned on the right in our illustration. It automatically puts the Westinghouse brakes of the coaches in action when the vacuum brake of the engine is applied.



THE CAB, LOOKING FORWARD



FRONT VIEW



G.W.R. FOUR-CYLINDER EXPRESS LOCOMOTIVE

50 B.H.P. CRUDE OIL ENGINE

ROBEY AND CO., LTD., LINCOLN, ENGINEERS

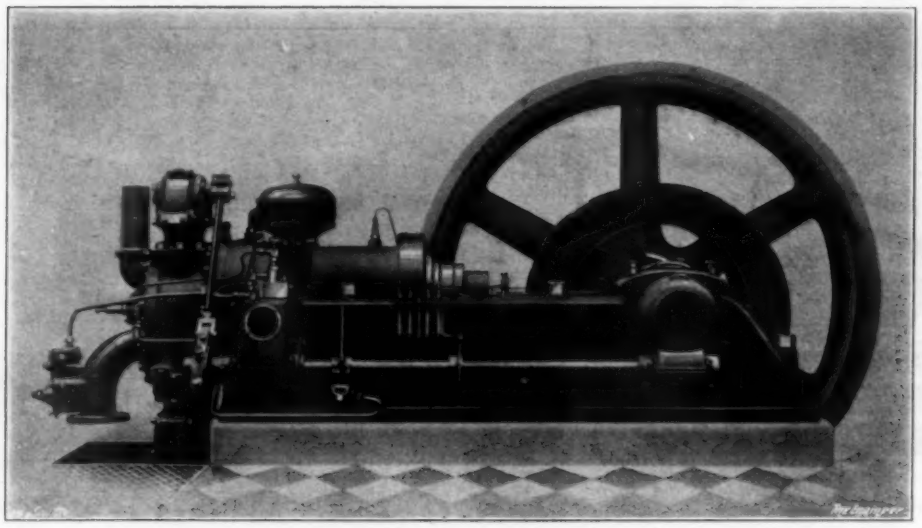


FIG. 1

The Royal Agricultural Society's Show at Newport, Mon.

No. I.

THE eighty-sixth annual Show of the Royal Agricultural Society of England is to be held next week at Newport, Mon., commencing on Tuesday, under the presidency of Viscount Tredegar. Compared with previous years, the entries of exhibits in practically all sections show a somewhat serious decline, owing no doubt largely to the depression in every branch of industry, as well as to the somewhat out-of-the-way part of the country in which the Exhibition is to be held. The number of exhibitors' stands in the implement yard is 369, which require 9486 square feet of shedding, compared with 446 stands and 10,870 square feet of shedding at the Reading Show last year. The entries in the live stock sections are

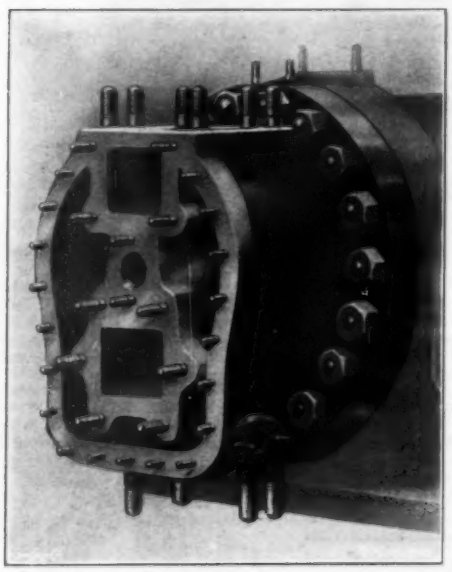


FIG. 2—BREECH-END OF OIL ENGINE—ROBEY

correspondingly low, being 2871 compared with 4031 at Reading.

The production of agricultural implements in this country has not yet recovered from the fall during the war period, and the total export trade to Europe during the first three months of the present year only amounted to £71,270. With the Overseas Dominions and Colonies the trade was somewhat better, and it would appear that British implements are increasing in favour in those parts, Australia and British South Africa being the best markets for British productions. Notwithstanding the depressing conditions which British implement builders are experiencing, the engineering section should prove attractive to colonial buyers, who still look to the Mother Country for a lead in everything appertaining to agriculture. There is quite a large number of entries for the Royal Agricultural Society's silver medals, and the Ministry of Agriculture and Fisheries will have an important stand for demonstrations designed for the purpose of bringing improved methods of marketing to the notice of home producers and to all who handle home produce. The National Institute for Research in Dairying, at Reading, will also arrange demonstrations of clean milk production. One of the most attractive

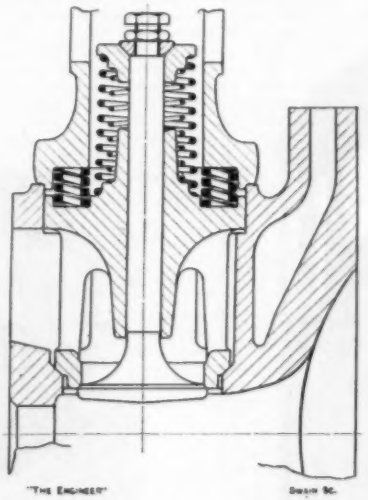


FIG. 3—RELIEF VALVE OF OIL ENGINE—ROBEY

stands in the showyard will be that of the British Electrical Development Association, for on it the application of electricity to almost every conceivable branch of farming will be shown under the supervision of Mr. R. Borlase Matthews.

On the stand of Robey and Co., Ltd., of Lincoln, there are to be seen two of their most recently designed horizontal crude oil engines, one of 25 brake horse-power and the other 50 horse-power, illustrations of the larger of these engines being given in Figs. 1, 2, 3 and 4. The makers point out that in the design of these engines several new features are embodied, namely, an excentric drive for operating the air and exhaust valves, a spring relief valve for relieving excess pressure in the cylinder, a new type of sprayer or atomiser, and a flexible steel expansion plate for covering the back of the combustion chamber. A sectional view of the valve mechanism, given in Fig. 4, shows that the valve gear is driven by a large excentric from the lay shaft through compound levers, so as to relieve the lay shaft of heavy and sudden stresses. The valve levers are contained in dust and oil-tight cases with the object of ensuring quietness of running and long life to the wearing parts. The cylinder has a special form of breech end, designed to relieve all casting and working strains. It is cast

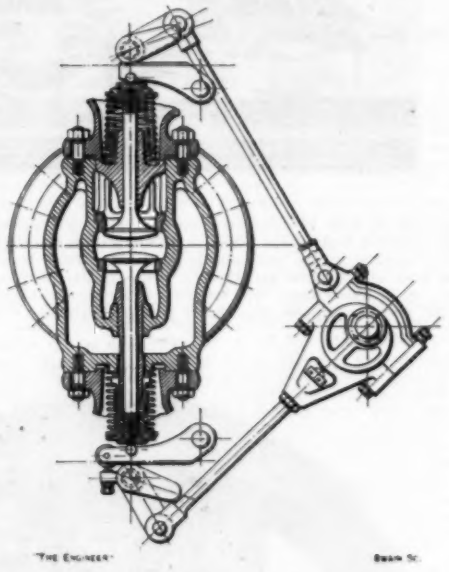


FIG. 4—VALVE GEAR OF OIL ENGINE—ROBEY

in a special metal to prevent growth and distortion, and has a "breathing" plate to allow free expansion and contraction, as well as to facilitate the cleaning out of the water spaces. The fuel pump, which is of solid steel, is constructed without packing rings or glands, and there is a simple means of regulating the stroke of the pump without putting excessive work upon the governor. The piston is specially designed to avoid distortion and to prevent abnormal heat reaching the gudgeon pin. It is arranged with extra deep sealing rings, constructed so as to dissipate the maximum amount of heat to the liner walls, and to reduce wear of the liner and piston ring grooves. The construction of the relief valve, to which reference has already been made, is shown in Fig. 3. The valve comprises a spring-loaded valve cage with the seating outside, but concentric with the air valve proper, so that any excess pressure in the cylinder may cause the cage to lift off its seating and allow the products of combustion to escape round the annular space between the cylinder head and the casing itself. The sprayer or atomiser is of simple construction, and is provided with ready means for regulating the tension of the spring which accentuates the plunger so as to give a range of pressures to suit oils of different

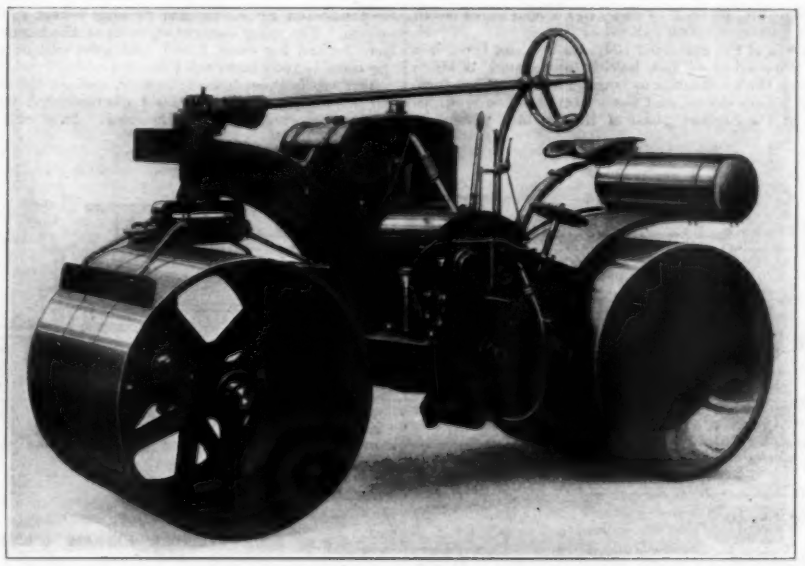


FIG. 5—3-TON TANDEM ROAD ROLLER—ROBEY

grades, as well as for adjustment of the plunger to varying conditions. These engines are built in single-cylinder units ranging from 15 to 100 brake horse-power.

The main frame of the engine is of heavy box section, well reinforced by ribs, and it is fitted with split ring oil bearings for the crank shaft. It will be noted that the frame between the bearings and cylinder is brought well above the centre line of the latter, which gives a very rigid appearance. There is a separate liner for the cylinder, which is ground inside and turned on the outside to ensure even expansion throughout. The control of the engine is made easy by adjusting the amount of each fuel charge. A simple plunger pump with a variable stroke forces the oil through the atomiser. The stroke of the pump is regulated by a sliding roller actuated by the governor, and the latter is of the spring-loaded type driven by a silent chain from the lay shaft through spiral bevel gear running in oil. Ring lubrication is fitted on the crank shaft and lay shaft bearings, and forced lubrication is provided to the piston on to the exhaust valve spindle.

Messrs. Robey also exhibit a tandem steam road roller of 7 tons weight, fitted with their instantaneous reverse gear, and one of their latest 6-ton tipping wagons, the features of which have already been described in THE ENGINEER.

The same firm is showing for the first time a new type of road roller, which is illustrated in Figs. 5, 6, 7, and 8. This tandem roller has been designed to meet the increasing demand for a light roller, suitable for making and repairing roads and footpaths, and also for use on golf links, cricket grounds, race-courses, &c. The chief characteristic of the machine is the "clear side" arrangement, which permits the rolls to work close up to walls, trees, or other obstructions. The clear side for rolling is obtained by carrying the front axle in a single arm fork made of forged steel—see Fig. 8—which is attached to a master pin supported by the front head bracket, and also transmits the steerage which is operated by worm and quadrant. The rear axle is also only supported on one side and is held by the main gear-box casing. The main frame is formed by bolting together the front head bracket, and the main gear-box casing, these being made of cast steel and made specially strong in view of the rough work they have to do. The front and hind rollers are made of cast iron, and are fitted with phosphor bronze bushes, the front rollers being made in three sections to facilitate steering. A ball race is fitted between the front master pin and head bracket to reduce friction.

The engine, which is of the high-speed four-cylinder petrol type, giving 12 B.H.P., is fitted with a governor, a Zenith carburetter, and a B.T.H. magneto. A radiator having a large cooling surface, and of the thermo-syphon type, is arranged on the top of the main gear-box. The engine is coupled up to a flexible joint which, in turn, is fixed to the main shaft in the gear-box. On this main shaft is a double cone clutch which drives by means of silent chain and spur gearing the two-speed gear on the countershaft, the gear is coupled up to the inner disc of the clutch, which is free to engage in either cone clutch ring, the latter, in turn, driving the countershaft by means of either silent chain or spur gearing giving the forward and reverse respectively. The driver's seat is spring mounted, and from it all the control handles can be easily reached. Adjustable scrapers are fitted to both front and hind rollers.

The following are the principal particulars of the roller:—Overall length, 9ft. 1in.; overall width, 4ft.; overall height, 5ft. 9in.; diameter of front and hind rolls, 3ft.; width, 3ft.; wheel base, 6ft. 1in.; brake horse-power of engine, 12; road speeds, both forward and reverse, 2 and 4 miles per hour; capacity of petrol tank, 4½ gallons.

James and Frederick Howard, Limited, of Bedford, are represented by a 31 brake horse-power petrol locomotive of similar type to that described by us last year. A view of this machine is given in Fig. 9. It is fitted with an auxiliary rubber-tired wheel, which, when required for additional adhesion, runs on a central track between the rails, and enables heavier

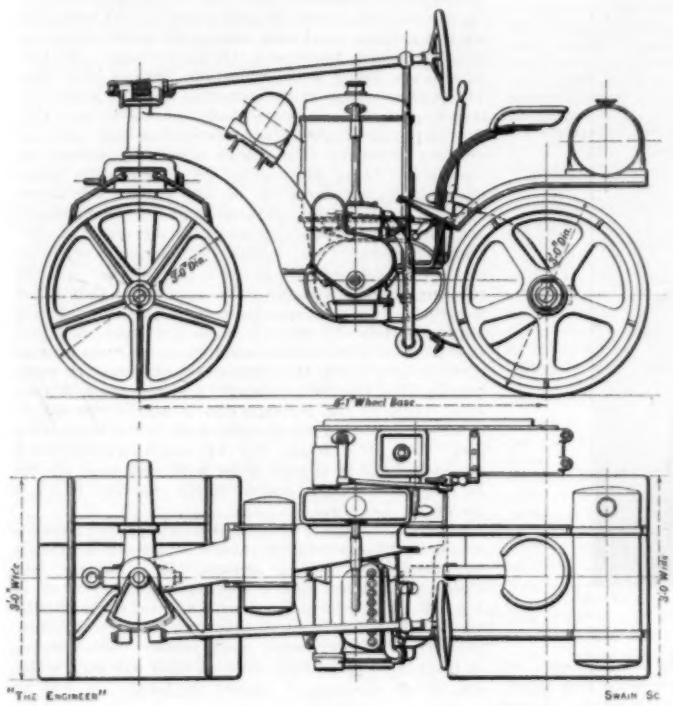


FIG. 6—8-TON TANDEM ROAD ROLLER—ROBEY

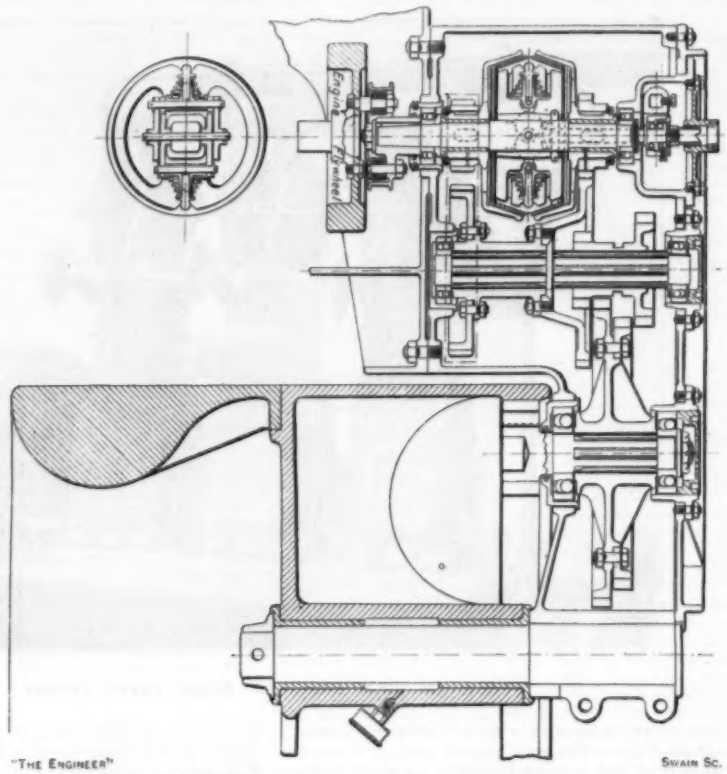


FIG. 7—TRANSMISSION GEAR OF TANDEM ROAD ROLLER—ROBEY

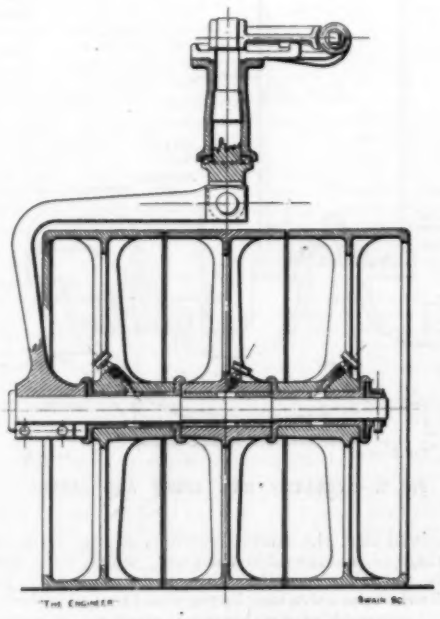


FIG. 8—SECTION THROUGH FRONT ROLLER

FIG. 9—31 H.P. PETROL LOCOMOTIVE—J. AND F. HOWARD

loads to be hauled than is possible when only the ordinary metal-tired driving wheels running on rails are used. It should be stated that the central track is usually only provided on gradients. It may be made of any suitable material, such as concrete, hard wood, &c. The locomotive weighs 3½ tons. The engine is of the four-cylinder vertical type, with cylinders 100 mm. bore by 140 mm. stroke, and it develops 31 brake horse-power at 1000 revolutions per minute. The clutch is of the fabric-lined cone variety, and the gear-box gives two speeds in either direction, one hand lever sufficing for all movements. Power is transmitted from the gear-box by means of a roller chain to the front axle, and another roller chain drive is provided between the front and back axles, all four wheels being thus positively driven. The auxiliary adhesion wheel is made of cast steel, and consists of a central machine-cut chain sprocket on either side of which is a projecting boss to which two steel rims are securely fixed. The wheel has a solid rubber tire, and is centrally driven by a roller chain from a machine-cut steel sprocket on the rear axle. The auxiliary wheel rotates on ball bearings on a "dead" axle, the ends of which are housed in axle boxes fitted with excentric chain adjustment. These boxes slide in horn guides fixed to the main frame. The axle of the auxiliary wheel is carried by a cast steel spring fork, the height of which is regulated by a screw and hand wheel under the control of the driver. A strong spring in the fork is compressed when the wheel runs upon the central track and the pressure can be adjusted by the driver.

Tests on this type of locomotive have demonstrated, so we are informed, that the haulage capacity is increased to a remarkable extent by the use of the adhesion wheel.

A three-cylinder vertical oil engine of 120 brake horse-power, exhibited by Davey, Paxman and Co., Ltd., Colchester, is illustrated in Fig. 10. This engine embodies a spring-injection system consisting of a governor-controlled low-pressure measuring pump, which delivers the fuel to a self-contained unit bolted to the head of the cylinder. This unit is a combined loader and atomiser, and is the only part of the fuel system under pressure. By its use, the injection takes place at the same pressure and at the right moment, whatever may be the speed of the engine, while, at the same time, it avoids the necessity for either an air compressor or high-pressure fuel pipes. The valve mechanism is of the "Paxman" Lentz type, and comprises an excentric-operated cam acting upon a roller, the latter being carried on a pin passing through the guide and acted upon at its extremities by adjustable tension pins. The valve itself is screwed into the guide from which it can be easily detached, so as to enable the latter, together with the roller, to be drawn back into the bonnet, thereby leaving the valve free for grinding or for inspection, without having to dismantle the entire mechanism. The tip of the cam is made to dip into an oil bath contained in the base of the bonnet to ensure efficient lubrication of the cam roller and guide. The peculiar form of the cam used enables the cam to be raised from and lowered on to its seat without shock at all speeds, thus giving silence in operation and long life to the wearing parts. The governor, which is of the spring-loaded type, is sensitive in operation and adjustable while the engine is running. We are informed by the makers that a fuel consumption of 0·4 lb. per brake horse-power per hour can be obtained on all but the smaller sizes of engine, and that the engines can be started against half load while cold without preliminary heating. These engines are manufactured in sizes from 25 brake horse-power upwards.

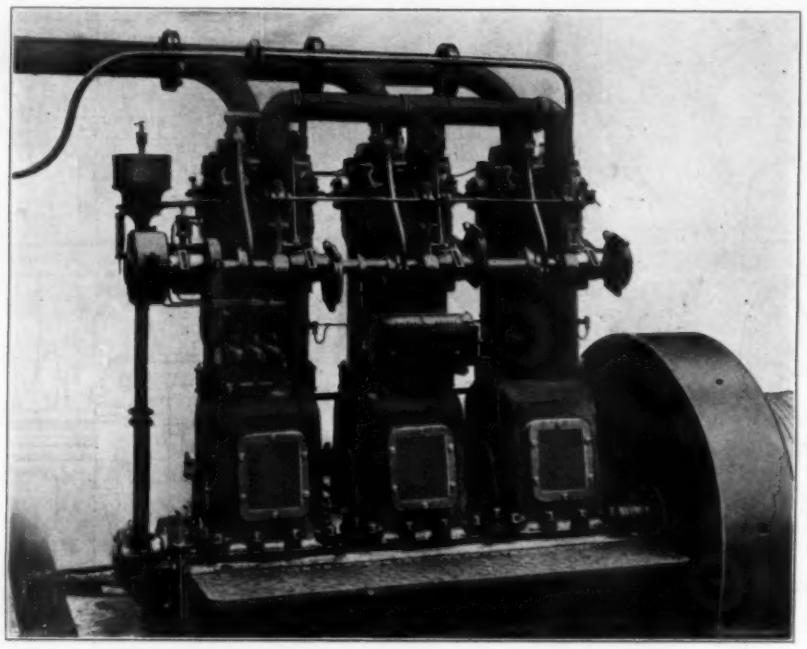


FIG. 10—120 B.H.P. HEAVY OIL ENGINE—DAVEY, PAXMAN

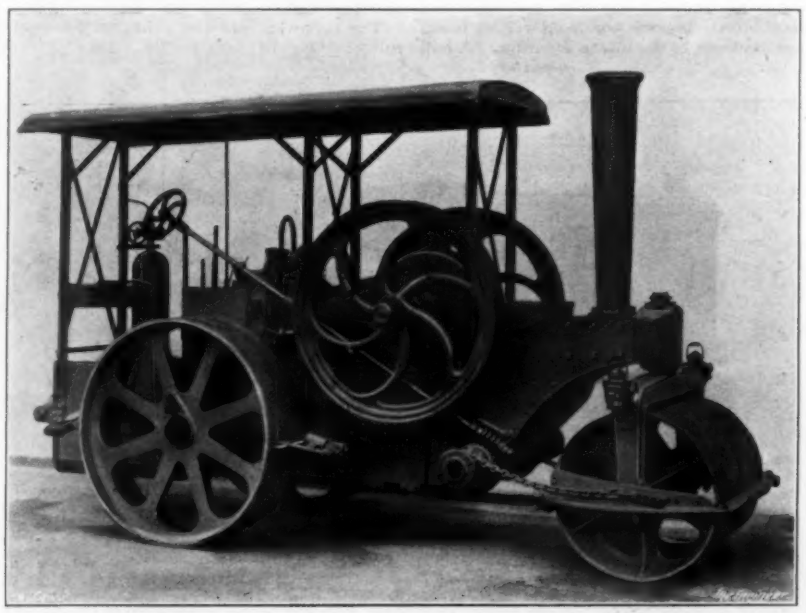


FIG. 11—6-TON ROLLER WITH CRUDE OIL ENGINE—AVELING AND PORTER

In addition to several of their standard type road rollers, Aveling and Porter, Ltd., Rochester, are exhibiting one of their crude oil-driven machines, weighing 6 tons when empty. This roller is designed and built on similar lines to this firm's steam roller, but the prime mover is a single cylinder four-stroke heavy oil engine of the horizontal type. The engine is provided with a governor to regulate the supply of fuel to the cylinder, in accordance with the requirements. It is claimed that any grade of fuel may be used provided that it is clean and sufficiently fluid to be pumped cold, and no auxiliary fuel is necessary for starting, nor is a starting lamp or other heating arrangement required. Starting, stopping and reversing of the machine are all performed by one lever, and all the gearing is of cast steel with teeth of special form to ensure quiet and steady running. All four wheels are fitted with renewable rims of cast iron. The makers claim that, with this type of roller, the engine parts are all particularly accessible, and that the piston is thoroughly lubricated at the point of greatest pressure. The engine is water jacketed, the circulation being maintained by means of a pump operated by an excentric on the engine side shaft. The self-starter is air operated, and the arrangements are such that the re-charging of the air vessel is automatically carried out whilst the engine is at work, so that a full pressure is always available, and the time required to put the roller to work is only a few minutes. Two road speeds, in both directions, giving approximately 2½ and 1½ miles per hour, are provided. The frame of the machine is built up of steel plate, and it forms the engine bed carrying the main bearings for the various shafts and the main driving axle, while at the forward end it carries the saddle in which is housed the upright stem of the front roller fork. Our illustration—Fig. 11—shows a roller which has been built to special order with cast steel wheels. In other respects, it resembles the machine which is shown at Newport.

Green and Carter, Ltd., of Winchester, are showing a new hydraulic ram for raising water automatically by means of a flowing stream. It is called "The Vulcan," and we give a sectional drawing of it in Fig. 12. This ram is fitted with a novel form of pulse valve, which has been designed to obviate the difficulty that is experienced with rubber valves, owing to their bending as they close on their seatings, which are either concave or convex in form. It will be observed that the rubber valve is in the form of a ring of considerable thickness, which rises and falls vertically parallel with a flat seating. In order that the valve may be regulated to deal with the varying quantities of power water which are available, as well as to guide the valve in its travel, the valve is enclosed in a circular cage concentric with and supported on a screwed spindle, and the latter passes up through a central boss formed on the valve seating. The movement of the valve can thus be adjusted by screwing the spindle up or down as required and locking it with a lock nut. The circular cage is provided with angular slots through the bottom plate and with openings through the sides. These slots and openings cause the valve to turn slowly, and thus cause it to wear evenly on the face while preventing it from bedding into the ports.

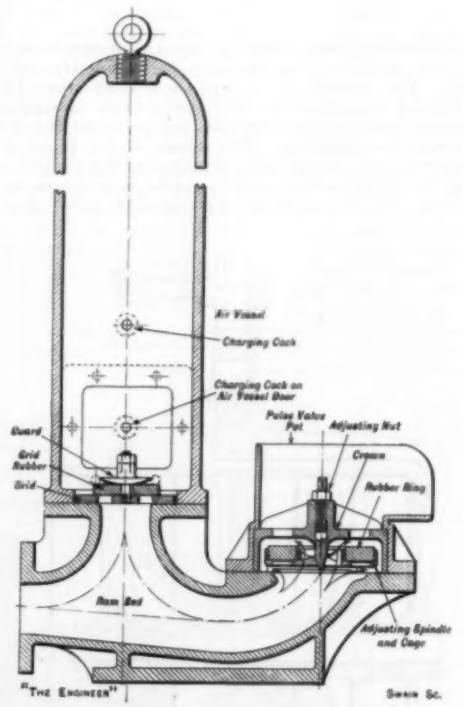


FIG. 12—HYDRAULIC RAM—GREEN AND CARTER

(To be continued.)

Railway Matters.

A NEW electrically operated train has been placed in service on the Metropolitan Railway. It will enable that company to cover the distance between Watford and Baker-street in approximately half an hour. It has a horse-power of 2500 and a tractive effort, at starting, of 30,600 lb., and is capable of attaining a speed of 65 miles per hour. The coaches seat 482 passengers, as compared with 318 in the older trains.

ON page 108 of THE ENGINEER of July 31st, 1925, we had an article on the collection of engravings and other old curiosities relating to early railways that have been made by Mr. Isaac Briggs, of Wakefield. Mr. Briggs died last December, and Miss Briggs has now handed over her father's collection to the Railway Museum at York. Stroudley's locomotive Gladstone is also there now, having travelled to York by the Great Central route a month ago.

A PARTY of Canadian-Pacific Railway engineers, headed by H. M. Dibble, assistant engineer of the line, have begun work surveying in the Lake St. John District, in the vicinity of Ste Anne de Beaupré. The object of the survey is to ascertain the most suitable spot where the projected line from Quebec to Lake St. John could leave the St. Lawrence Valley and head north-east. Similar surveys will be carried out near Baie, St. Paul, and Murray Bay, and the whole survey will probably require a year for its completion.

MENTION has, from time to time, been made in these pages to certain changes that are being made by the Southern Company at Leatherhead, which will allow the Guildford trains to use the former Brighton line station, and so concentrate the work of two stations in the latter. A new junction is necessary at the Dorking end of the station, and the new connection then crosses a main road. We notice that the bridge for the down line is completed, and the track laid across it, and that the bridge for the up line is in position.

THE Lord Mayor, in the earnest desire to promote goodwill in industry, is holding a series of receptions at the Mansion House, to which it is proposed to invite representatives of the principal industries of the country, including directors, officers and various grades of workpeople. The first of the series was connected with railways, and the gathering took place on Wednesday evening last, June 29th, when over 1000 representatives of the railways were present. The members of the staff invited were given free travelling facilities and leave of absence without loss of pay.

ON May 25th Major Glyn made some inquiries of the Minister of Transport as to the number of privately owned wagons, but all that Colonel Ashley could do in reply was to give figures as to the new wagons registered at the Railway Clearing House. Recently the question was amended so as to suggest that the Minister should ask the owners how many wagons had been broken up. Colonel Ashley, on this later occasion, answered that the question of privately owned wagons was one of the matters under consideration by the Standing Committee on Mineral Transport—see page 216 of THE ENGINEER of February 25th last.

SPEAKING at the annual meeting of the Southern Railway on February 25th, 1926, the late Sir Hugh Drummond, the then chairman, said that the company had three routes to Dover, and it was desired to make them all available for engines of the "King Arthur" class. That *viâ* Folkestone could already be used, and it was hoped to have that *viâ* Swanley and Maidstone ready the following month, but the third, *viâ* Chatham, would not be available until the summer of 1927. It is a satisfaction to be able to say that there is every prospect of Sir Hugh's hopes as to the last being fulfilled, as on Sunday last, the 19th, a new bridge was opened which carries the former Chatham line over the Strood and Maidstone line of the old South-Eastern between Sole-street and Rochester.

ONE of the pre-war schemes of the former Midland Railway Company was to continue its Royston–Thornhill line to Bradford, and there to join its original line from Shipley. That would have put Bradford on the main line. The two stations—the Lancashire and Yorkshire and Great Northern jointly owned Victoria Station—and the Midland were to be joined by a viaduct, and part of the scheme was the building of a fine thoroughfare on each side of the viaduct to be called Kingsway. The city authorities approved because of the benefits that would come from Bradford being on the main line. The war stopped progress being made, and eventually the powers lapsed. The railway company had, however, bought 230,000 square yards of land, and that was sold to the Corporation in 1919 for £295,000. The question is again in evidence because the Bradford Corporation is now preparing plans for utilising the valuable properties that have come into its possession and so remodelling the central area of the city.

IT has long been felt that even though the configuration of the country precludes anything like a direct railway line from Paris to Nice, something might nevertheless be done to avoid the long loop from Avignon to Marseilles and Toulon, which all trains for the frontier have to take at present. A new line, linking up Avignon with Nice *viâ* Chateaurenard, Salon, and Aix-en-Provence, and joining the existing line again at Les Arcs, has been traced out. Not only would such a line materially shorten the journey to Nice, but it would also open up to tourists a charming corner of Provence which is now neglected on account of the imperfect communications. A delegation of the Council-General of the Bouches-du-Rhône was recently received by Monsieur Andre Tardieu, the Minister of Public Works. After having listened to all the explanations which were put forward by the delegates, Monsieur Tardieu expressed his sympathy with the scheme, and suggested the setting up of a Committee which would collect all the proposals put forward, and on which the Bouches-du-Rhône, the Var, the P.L.M. Railway Company, and the Ministry of War would be represented. Monsieur Tardieu offered to give his personal consideration to the suggestions made by the Committee. The Director-General of the P.L.M. Company received the same delgation, and assured the members that he would give his most serious attention to the matter.

Notes and Memoranda.

RECENT search, it is stated, along the railway to Orsk in the Southern Ural has led to the discovery at Khalilovo and elsewhere of hitherto unknown deposits of chromite. The ore found near the village Balkasse is reported to carry 43·91 per cent. of Cr_2O_3, and that found near Gainullina 39·06 per cent.

IT is hoped to open the first automatic telephone exchange in London during the coming autumn, two others by the end of the year, seven more during 1928, and a large number during succeeding years. The exchanges to be opened this year are Holborn, Bishopsgate and Sloane; and the three next year will be Western, Monument, with probably Bermondsey.

ACCORDING to the official report for the Suez Canal, the number of vessels that passed through the Suez Canal last year was 4980, aggregating 26,060,377 net tons, or 701,558 tons less than in 1925 (the record year), but 950,495 tons more than in 1924. The tonnage of the 401 vessels that passed through the Canal in ballast was 1,768,677 net tons last year. The aggregate net tonnage of the 2744 British vessels was 14,968,938 last year, or 57·4 per cent. of the total. Dutch vessels were represented by 11·0 per cent., German by 8·3 per cent., French by 6·7 per cent., and Italian by 5·2 per cent. of the total net tonnage.

THOSE who work with aluminium electrolytic rectifiers for high-tension supply are often troubled with excessive corrosion of the aluminium electrodes at the point where they enter the solution. This may be avoided, states a writer in the *Wireless World*, by making the aluminium electrodes of round rod and fitting them with a tight sleeving of rubber tubing where they enter the solution. This rubber tubing should extend at least an inch above and below the surface of the solution. When rubber tubing is thus used it is not practical to use a layer of oil as is sometimes suggested, as oil ruins rubber after a short time.

THE work of carrying out an electrification scheme for part of the Higher Walton Mills of G. and R. Dewhurst, Ltd., is being undertaken by the Metropolitan-Vickers Electrical Company. Group drive has been adopted, and eight motors, ranging from 350 H.P. to 10 H.P. and totalling 820 H.P., are to be installed to replace beam engines driving machinery in two weaving sheds with 1600 looms, a mule spinning room with about 11,000 spindles, a size-mixing room, warehouse and workshops. The larger motors are to be of the slip-ring type and the smaller motors of the squirrel-cage type. Suitable control gear and a five-panel switchboard are included in the order.

THE International Aeronautical Exhibition which was held in Prague from June 4th to 16th, attracted considerable attention, both in Czecho-Slovakia and abroad. The local aircraft industry was represented by exhibits of four aeroplane factories producing civil and military types of machines, and by three aero-engine works which manufacture their own, in addition to foreign designs under licence. Among the latter was the well-known British Jupiter aero-engine, while De Havilland aeroplanes of local manufacture have made a good name for themselves on the State Air Lines, operating a regular passenger and mail service between Prague and Slovakia. Vickers Ltd. was the only British exhibitor at the Exhibition.

TRUE laterites and lateritic ironstones are, according to Dr. A. L. du Toit, widespread in tropical and sub-tropical countries, and a great deal has been written about them, though very little research has yet been done on the representatives in South Africa, despite their interesting character and importance. They have arisen largely from the extremely slow decomposition of the underlying rocks—which may be of various kinds—but under peculiar conditions, which are not altogether understood. In the true laterites, the breaking up of the silicates has led to the removal of the silica, alkalies and akaline earths, leaving hydrated oxides of iron and alumina chiefly. In the lateritic ironstones the silica has been set free or left combined with the alumina as silicate, and is accompanied by a variable amount of hydrated oxides of iron. The proportion of silica ranges from about 60 to 80 per cent.

THE Non-Ferrous Metals Research Association is co-operating in a scheme for linking the Government service interests in electro-deposition with industrial developments and applications. In recent years electro-deposition, particularly so far as nickel and chromium and the protection of aluminium are concerned, has experienced a sudden revival. Much of this new work has been carried out for service or other limited interests, and was not readily available to industry. The arrangements made by the Department of Scientific and Industrial Research have provided a sum of £5000 to be expended over three years to undertake investigations at the Research Department, Woolwich, the Royal Aircraft Establishment at Farnborough, and at the Sheffield University. At present the subjects under investigation include—(*a*) pitting and pinholes in deposits of nickel, iron and chromium; (*b*) protective zinc coatings for aluminium alloys; (*c*) internal stress in thin nickel deposits; (*d*) use of sodium cyanide in silver plating baths.

THE Canadian Government announces that it has decided to extend the activities of the Advisory Council for Scientific and Industrial Research. The most important feature of this expansion will be the establishment at Ottawa of national research laboratories directly under the control of the Research Council. The function of the laboratories will be twofold: (1) Standardisation work of all kinds similar to that being conducted by the Bureau of Standards at Washington, D.C., or the British Engineering Standards Association; (2) to make provision for the carrying out of research work in the laboratories which will be open for private firms, who desire to conduct investigations under the superintendence of the permanent staff of the Council. Any private corporation will be able to engage a researcher to conduct an investigation into any problem affecting its business and will be able to retain the results for itself after paying the cost of the laboratory facilities. A study of the British methods of research work is one of the objects of the present visit of Hon. James Malcolm, Minister of Trades and Commerce, to England.

Miscellanea.

A PLANT for the extraction of oil from the tar sands of Alberta is to be put up at Edmonton, at a cost of 200,000 dollars.

THE effect that the Aurora Borealis, or Northern Lights, has on radio transmission is being studied by the National Research Council of Canada.

NEGOTIATIONS are said to be proceeding between Polish collieries and the Algerian State Railways with regard to supply of coal from Upper Silesia. As a trial supply, an order of 25,000 tons of coal is to be sent from Poland to various Algerian ports.

THE wireless station at Wuchow, China, was the first of its kind built in Kwangsi province, and is capable of communicating within a radius of 1500 miles. Larger and more powerful stations to reach 2500 miles are being installed at Kweilin, Nanning, and Lungchow.

THE Chilean Government is supporting an invention in which iodine in solution is to be used for the extraction of copper. An agreement has been entered into by which a large quantity of iodine is to be made available for the tests of this new process, invented by Senor Amenabar.

AT the recent general assembly of Austrian iron and steel works, held at Leoben, Dr. Apols, the general director of the Alpine Montan Company, expressed the opinion that the Austrian iron and steel industry can only be saved from ruin by enlarging its economical territory, and this can only be done by working hand in hand with the German industry.

A COKE and gas plant, including a battery of 59 Koppers combination coke ovens and a by-product plant for the recovery of tar and ammonium sulphate, is being erected at Montreal. It is stated that this plant will have an annual capacity of approximately 350,000 tons of coke, 6500 million cubic feet of gas, and 3,500,000 gallons of tar, and 10,000,000 lb. of ammonium sulphate.

A MESSAGE from Brussels states that the Belgian Minister of Public Works has approved the conditions for a contract drawn up by the Department of Roads and Bridges, with a view to putting up for public tender the work of closing the open portion of the Zeebrugge Mole and the widening of the platform of the part of the jetty which is on piles. The cost of the work is estimated at 5,975,000f.

AUTHORITY to spend 3,000,000 dollars for extensions to the provincial hydro-electric system in the next four years has been given by the Manitoba Government. Contracts for new construction work to the value of 1,000,000 dollars have recently been awarded by the Manitoba Hydro-Electric Commission. Private electric power companies are also making substantial extensions to their power plants and systems in several parts of Manitoba.

AFTER the ventilating equipment and fire-fighting apparatus are installed, and before the Holland tunnel, New York, is open to traffic, a commission intends to make fire tests approximating, as closely as possible, actual conditions, to the end that the police upon whom the responsibility for the prevention of panic will rest, may be assured that the ventilating system will care for the smoke, and that the fire-fighting apparatus is adequate.

THE Committee of Belgian Public Works met on June 27th, under the presidency of Monsieur Francqui, and unanimously adopted a report on the work of the sub-committees dealing with the building of barrages and reservoirs to control the water in the canal between Antwerp and Liége, with the building of dykes on the Meuse and with railway communication between the port of Antwerp, Ghent, and the industrial districts, &c. The report was afterwards transmitted to the Government.

IT is with regret that we record the death at the early age of forty-one of Mr. Allan Crombie, M. Inst. C.E., Chief Engineer to the River Wear Commission at Sunderland. Mr. Crombie was an Aberdeen man and a pupil of Mr. R. G. Nichol, the harbour engineer. Subsequently he went to Sunderland as assistant to Mr. W. Simpson. Mr. Crombie carried out several installations at the latter port, including the erection of belt conveyors for coal, the building of a new sea wall and wave basin, and the erection of coal staiths.

PAISLEY Town Council has decided to undertake the wiring and lighting of the common stairs, passages and private courts in all suitable properties by electricity at a charge of £1 per lamp per annum. The public lighting of the whole town is now provided entirely by electricity, special distributing cables having been laid in every street. It is intended to lay a service cable from the street lighting cables to each block of tenement houses and to feed the common stair lights for the whole block from one service. All the stair lights, as well as the street lighting, will thus be controlled at the power station. It is expected that the scheme will be completed within two years.

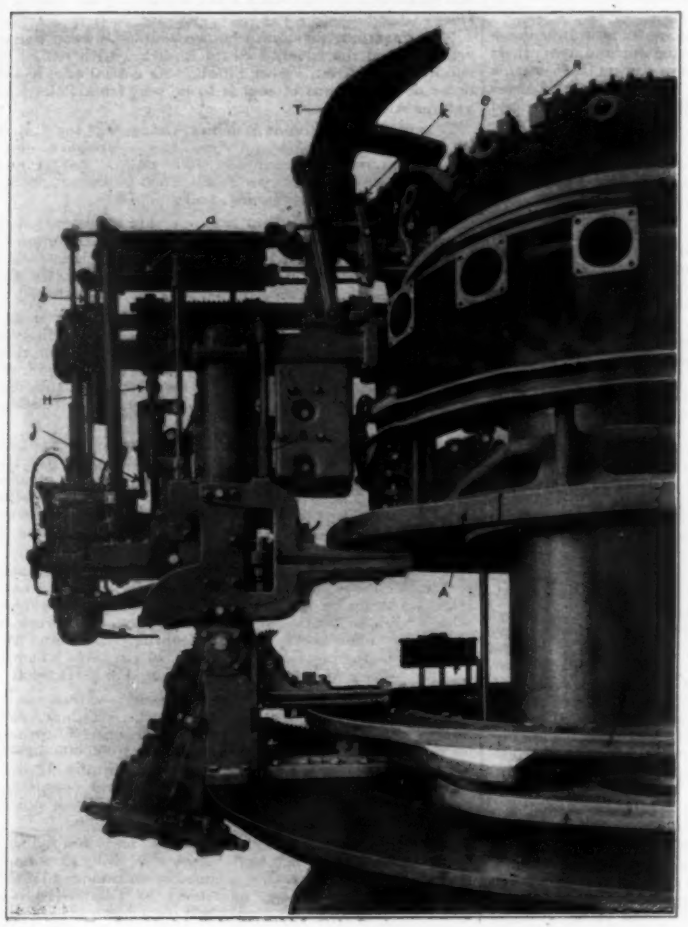
AT the International Exhibition, which will be opened at Barcelona on April 1st, 1929, and remain open for some months, the buildings occupied by the Industrial Group will include the Palace of Light, the Palace of Industry, and the Palace of Communications. In the first-mentioned building, industrial exhibits relating to lighting and its technique, with apparatus used in theatres and for advertising, will be displayed. Hydro-electric methods and plans for utilising tidal and solar energy will also be exhibited. In the Palace of Industry, the electrical power production and lighting and heating industries will be shown in their purely commercial aspect. In the Palace of Communication, space will be allotted to transport work, telegraphy, telephony, wireless, &c.

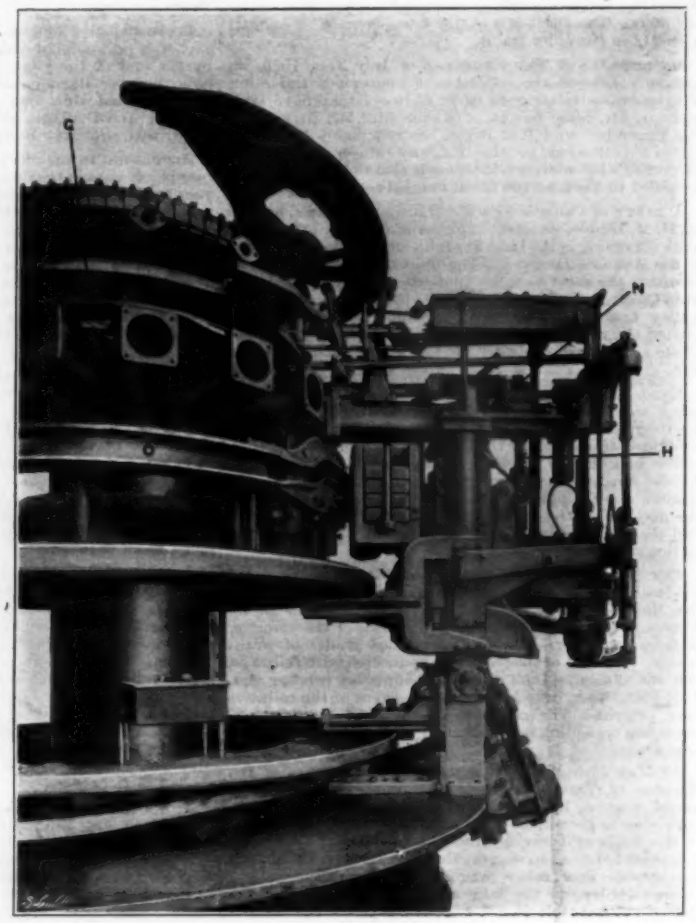
UNDER the auspices of the Canadian Engineering Standards Association, a representative committee on the Canadian electrical code has approved a draft code covering electrical wiring and the installation of electrical apparatus in Canada. The Provincial Governments will co-operate with the necessary enabling legislation giving the national endorsement, thus obviating the multiplicity of regulations now existing in the various provinces, and also the necessity of securing the approval of the Chicago laboratories, as hitherto required by the Insurance Underwriters' Association. British exporters of electrical apparatus for use in Canada have frequently protested against the discrimination of Chicago in refusing to endorse British equipment for installation in Canada.

FIFTEEN ARM BRITISH GLASS BOTTLE MAKING MACHINE

DESIGNED BY MR. F. REDFERN AND MADE BY THE METROPOLITAN-VICKERS COMPANY, LTD., TRAFFORD PARK

(*For description see page 3*)





FIGS. 8 AND 9—ONE UNIT, WITH TABLE LOWERED, VIEWED FROM OPPOSITE SIDES

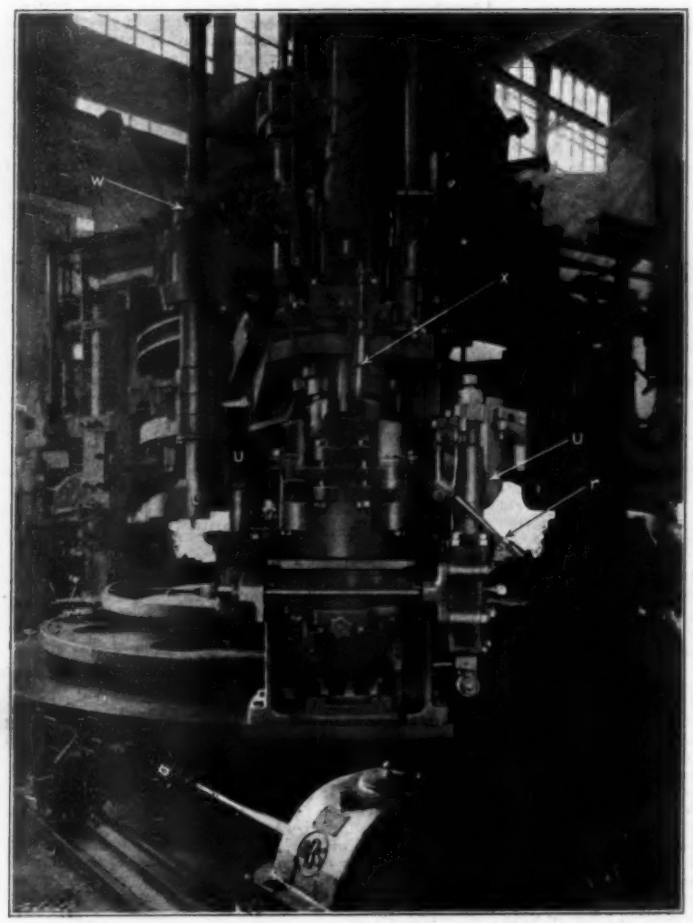


FIG. 10—FRONT OF UNIT—TABLE UP

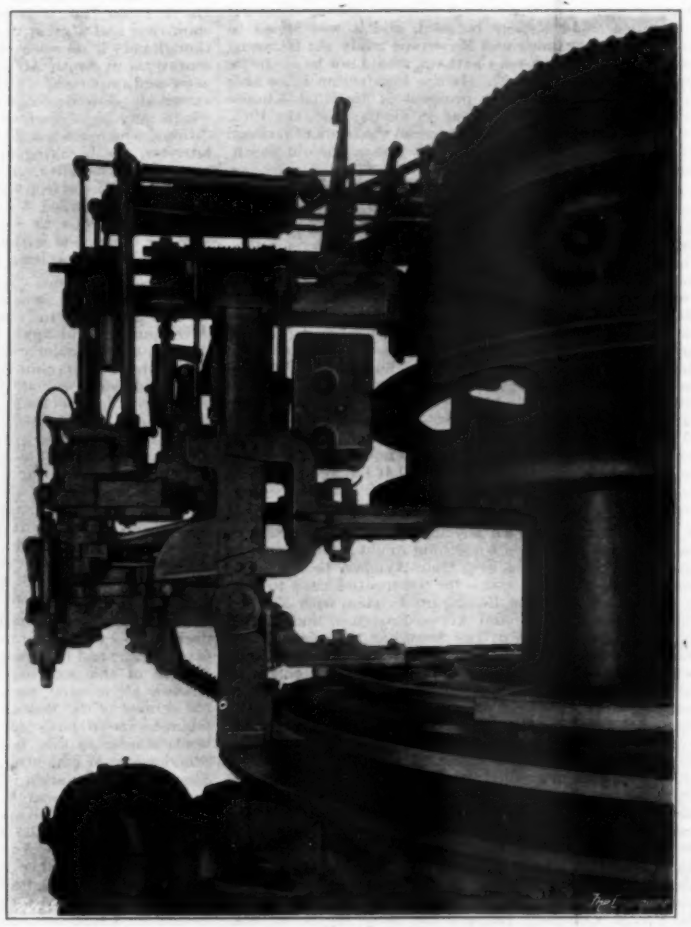


FIG. 11—SINGLE UNIT WITH FINISHING MOULDS CLOSED

The Engineer

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Contents.

THE ENGINEER, July 1st, 1927.

	PAGE
A SEVEN-DAY JOURNAL	1
LITERATURE	2
BOOKS RECEIVED	2
A LARGE BOTTLE MAKING MACHINE.—No. I. (Illus.)	3
DEVELOPMENT ON INDIAN BROAD-GAUGE RAILWAYS	6
AIRCRAFT CARRIERS	6
NEWCOMEN SOCIETY: SUMMER MEETING	8
NEW BRITISH ENGINEERING STANDARD SPECIFICATIONS	8
G.W.R. NEW FOUR-CYLINDER EXPRESS LOCOMOTIVE. (Illus.)	8
THE ROYAL AGRICULTURAL SOCIETY'S SHOW AT NEWPORT, MON. —No. I. (Illus.)	10
RAILWAY MATTERS	13
NOTES AND MEMORANDA	13
MISCELLANEA	13
LEADING ARTICLES—	
The Trades Disputes Bill	15
Industry and the Motor Car	16
INSTITUTION OF MECHANICAL ENGINEERS: SUMMER MEETING	16
SIXTY YEARS AGO	17
A NEW PORTABLE AIR COMPRESSOR. (Illus.)	18
THE INTERNAL COMBUSTION BOILER	18
COST OF NOISE	18
165-KW OIL ENGINE DRIVEN GENERATOR SET. (Illus.)	19
SOUTH AFRICAN ENGINEERING NOTES	19
A STRAIN GAUGE FOR MEASURING DEFLECTIONS. (Illus.)	20
LETTERS TO THE EDITOR—	
Development of the British Steam Locomotive	20
Engineers and Politics	20
A.S.L.I.B. Directory	20
THE EFFECT OF THE AUTOMOBILE INDUSTRY ON THE MIDLANDS. —No. I.	21
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	23
Lancashire	23
Sheffield	24
North of England	24
Scotland	25
Wales and Adjoining Counties	25
CURRENT PRICES FOR METALS AND FUELS	26
FRENCH ENGINEERING NOTES	27
BRITISH PATENT SPECIFICATIONS. (Illus.)	27
FORTHCOMING ENGAGEMENTS	28
CONTRACTS	28
PARAGRAPH—	
Institution of Mechanical Engineers	25

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THE ENGINEER.

JULY 1, 1927.

The Trades Disputes Bill.

MUCH has been said and written for and against the Trades Disputes Bill during the last few months, but notwithstanding violent opposition, it has safely emerged from the House of Commons. We have little doubt that it will appear on the statute book very much in its present form before the end of the session. The attitude of those who opposed the measure was one of uncompromising hostility. They suggested no amendments, ostensibly because it might be said that in doing so they impliedly approved one or all of the main principles which the Bill is framed to achieve. They were fain to support any argument advanced against those principles with abuse which was by no means invariably polite—wholly forgetting that the strength of an argument often varies inversely with the violence of the language in which it is sought to be maintained. There is an old saying, "No case; abuse the plaintiff's attorney." Does it not apply to causes which are heard in the High Court of Parliament as much as to those which are heard in the ordinary tribunals of the land? But possibly the absence of reasoned argument is not quite so remarkable when we consider the avowed objects of the measure. The very first clause appears to prohibit—or rather make illegal—any strike which "is a strike designed or calculated to coerce the Government, either directly or by inflicting hardship upon the community." Who would have the hardihood to say, in all seriousness, that such a law is wrong? With the disastrous experience of 1926 in mind there are but few leaders of public opinion who would not admit that a general strike is, to say the least, an egregious mistake; and if their spokesmen go so far, it is not too much to say that most working men would go much further, and rejoice to think that this particular method of advancing the cause of labour is definitely proscribed. There is hardly a trade union in the country which is not suffering, financially, from the stupendous burdens resulting from the cessation of work last year. The figures published a few days ago by the Amalgamated Society of Railway Servants show how soon the funds of a great union can be dissipated.

It will be noticed that we have said above that the Bill *appears* to prohibit a strike calculated to coerce the Government; but one point is quite clear from a perusal of the very first clause of the Bill. It is that a strike, the sole object of which is the furtherance of a trade dispute within the trade or industry in which the strikers are engaged, is and remains legal, *although* it may be calculated to coerce the Government either directly or by inflicting hardship upon the community. It is a complete perversion of the facts to say that this measure impedes or hampers the conduct of a strike within one particular industry in any way whatever. Furthermore, the definition of a dispute "within an industry" makes it plain that a dispute between workmen and workmen in that industry is included in that term. Thus there may be a strike with which employers are in no way concerned which is perfectly legal within the meaning of the Bill.

Nor—to remove another misconception—is a sympathetic strike necessarily illegal. It is only illegal if it is also a strike designed or calculated to coerce the Government either directly or by inflicting hardship on the community. The question whether such a strike is coercive will be for the Court to determine upon the facts of each particular case. The result of all this is that no strike can be illegal unless it involves coercion of the Government. Even a general strike is nowhere interdicted by the Bill, and it is possible to imagine strikes taking place simultaneously in, say, three of our largest industries, each of which, within the strict meaning of Clause I. of the Bill, is perfectly legal since it affects only persons engaged in that industry. Yet the effect on the community might be disastrous—almost as disastrous as a general strike. What are the legal consequences of an illegal strike? In the first place, those who foment or take part in it are guilty of a criminal offence; but it is significant to notice that the workman who merely lays down his tools and refuses to work does not—for this purpose—foment or take part in the strike. But there are other consequences, and who shall say they are unjust? An illegal strike must not be supported by the union funds, and the union which takes part in it is deprived of the protection afforded by the Trades Disputes Act, 1906. That extraordinary measure, whose operation during the last twenty-one years has been so largely responsible for abuses which the legislature is now anxious to check, rendered the trade union in its corporate capacity practically immune from every form of civil action. That immunity can no longer be enjoyed if the strike which causes the injury is declared by the Courts to be illegal. Space does not permit of our dealing with all the clauses of this important measure, but there is one which is deserving of special mention. We refer to that which seeks, in some degree, to prevent trades unions acquiring control in the domain of local government. With regard to persons employed by local authorities the Bill provides in effect that membership of a trade union shall not be made a condition of employment. Surely a salutary provision! There are some local authorities which wholly refuse to employ any but union labour. If your borough council were an ordinary employer, it might employ whom it liked upon any terms it thought proper, but, as Lord Phillimore took occasion to point out in a recent case in the House of Lords, a local authority is not an employer at all, but merely a steward in the administration of public money who is bound to give a faithful account of his stewardship to the ratepayers. And here one may venture to present a view which many people will regard as reactionary. Where is the statute which gives any person or any class of person a right to be employed by any local authority? If the local dustman is dissatisfied with the conditions of his service there is nothing to prevent him from throwing up his job and seeking another. Moreover, the new measure does not prevent a municipal servant from belonging to a union; he may join as many as he likes, but his union will no longer have any right to dictate terms to the local authority. It is to be observed that this provision comes into force immediately on the passing of the Act, when every condition in the contract of service of a municipal employee requiring him to be a member of a union shall immediately become void. Of the amendments introduced in the House of Commons, that which relates to the "lock-out" is of the greatest interest to employers. A "lock-out" means "the closing of a place of employment or the suspension of work, or the refusal by an employer to continue to employ any number of persons employed by him in consequence of a dispute, done with a view to compelling those persons, or to aid another employer in compelling persons employed by him

to accept terms or conditions of or affecting employment." This is a wide definition, but when the clause which deals with the "lock-out" is closely examined it is fraught with no grave consequences to any employer. Any "lock-out" —like any strike—is legal if its only object is the furtherance of a trade dispute within the trade or industry in which the employers locking out are engaged. It only becomes illegal if it has some ulterior object *and* is calculated to coerce the Government or to inflict hardship on the community. Nor is the sympathetic lock-out necessarily illegal. It only becomes so if it is calculated to coerce the Government or inflict hardship upon the community.

It is conceived that a final verdict upon the whole measure should be that it is one which carefully preserves the rights and privileges of every trade union, whether of workmen or employers. So long as those rights and privileges are not abused—so long as the trade union carries out its useful work without inflicting hardship on the worker who is willing to work, this Bill need have no terrors for those who are responsible for its management. Is it too much to say that in the exercise of the powers and enjoyment of the privileges conferred upon them in 1906 many trades unions have been examined and found wanting? Was not the Chancellor of the Exchequer wholly in the right when he said in the course of a speech in which he wound up the debate on the third reading of the Trades Disputes Bill:—"It is time to declare to our people, who have suffered from a world's record of industrial disputes, that industry must not be dragged into party politics? If Parliament is overridden, the alternative is dictatorship, not Socialism. If a junta be allowed to lay an interdict on industry, liberty is indeed dear. No one who cares for the general interests of the British realm can fail to vote, or would regret having voted, for a measure to preserve liberty and democracy."

Industry and the Motor Car.

IN recent years the reading of papers at the summer meetings of institutions has become less and less common. There was a time when two or three mornings were devoted to that practice, but the attendance was frequently very small, even when the papers were of considerable merit, and the opinion has gradually gained ground that it is better to devote the available time to visits to works and to that very essential element of all such meetings, the making of acquaintances and friends. The Institution of Mechanical Engineers has not yet gone quite as far as some other institutions—the "Electricals" for example—which have no papers at their summer meetings, but this year it came very near it, for only one morning was devoted to reading and discussion, and only one paper was taken. That paper, which is reprinted on other pages, was written specially for the meeting, and was designed to give visitors some idea of the effect which the introduction of a new industry—that of motor car building—has had upon the Midlands, the area which was being visited by the Institution. The author is Mr. H. Kerr Thomas, who, through his long connection with the automobile industry, was fitted in a notable degree to undertake its preparation. That he has done his work well will, we feel sure, be the opinion of all who read his paper.

Although many historians, and particularly historians of economics, have dwelt on the influence of industries upon the development of nations, the effect of any single industry has never been completely examined. The reasons are not far to seek. In the first place, we have the difficulty of settling upon "zero-hour"—that year in the age of a nation when a new industry can be said, positively, to have been introduced. In Europe nearly all industries are old, and the dates of their beginnings go back to a time when statistics were not preserved. All we can hope to find, all that we do find in the majority of such cases, are a few figures as to the numbers of hands employed in certain years, and some data upon the quantity of the product. The collateral effects are lost; we know they existed from the first, but they are so submerged in other contemporary events that it is well-nigh impossible to pick them out. Even the full influence of the rotatory steam engine or of the locomotive, relatively modern inventions, are only dimly seen through the mists of a century. Of all modern inventions, there is possibly none that gives the historian a better opening than that of the motor car. The date of its coming to Great Britain can be given almost to the day, it has risen with extraordinary rapidity, so that to many living men its whole history is known; it has grown up in a period when statistics and records are preserved; and it is more compact, more closely knit, than most other industries of recent introduction. We can, for example, trace its influence upon the production of new machine tools, of metallurgy, of rubber, leather, wood-working and even paint, with relative ease, and the careful historian might evaluate its effect upon "the road," with all that that word implies, without great trouble. Needless to say, Mr. Kerr Thomas has attempted nothing so comprehensive in his paper. To do it fully, even for the Midlands alone, would require not a paper of a few pages, but a book of many. As far as the technological side is concerned, he has restricted his inquiries to relatively few subjects, and principally to machine tools, metals and rubber. But in the second half of his paper he has opened up another line of inquiry—the effect of the motor car industry upon the artisan life of this country. When it is remembered that something like a quarter of a million people are directly employed on the manufacture of motor cars, or, approximately, one-eighth of all persons engaged in engineering, the great effect that that industry may exert upon other industries, and particularly engineering industries, is obvious. Mr. Kerr Thomas examines the question in two directions. First, the reduction of the proportion of labour costs in the total value of any product, and, secondly, the rate of wages that can, in consequence, be paid. Not so many years ago it was the practice to estimate on the basis that standing charges, materials and labour were all approximately equal; that is to say, that in every engineering product "labour" represented one-third of the cost of production. Any material increase in the cost of labour had therefore a marked effect. Nowadays, as the result of mechanical developments, "labour" has fallen in general engineering to about 20 per cent., but in motor car engineering it is down to no more than 11 per cent. It is astonishing to find, however, following Mr. Kerr Thomas's figures, that the oncost is only 14 per cent. In view of the very remarkable mechanisation of motor car factories, a higher figure might have been anticipated, and its lowness indicates how very efficiently the machines are used. It should be observed that "oncost" and "labour" are not far apart and that material bears now by far the highest percentage—75 per cent. in motor cars. The point of principal interest, is however, the low percentage of labour in a motor car—approximately, half that in general engineering products. It is that lowness which makes high rates of wages in the motor car trade possible. Under the old rule, doubling the labour cost meant an addition of one-third to the total cost; now the labour costs might be nearly doubled with an addition of only one-tenth. These obvious deductions prove again what has so often been pointed out to workpeople, that the increase in the use of machine tools and kindred appliances leads to higher wages; from the paper we learn that the average weekly wages for *all* classes of labour in the motor car industry were in 1926 79s. 5d., and that the industry is expending directly in wages at the present time no less than forty million pounds. If we look at this question of relative costs from the point of view of the consumer of motor cars, another deduction strikes us. Labour costs are clearly nearly as low as they can be, and the oncosts are surprisingly small. It is the cost of material that accounts for 75 per cent. of the total manufacturing costs of a motor car. If a further reduction in price is to be effected, it must, then, be sought first in the reduction of the costs of material. Can that be brought about by the adoption in steel, brass, aluminium, rubber, leather and other factories of a system similar to that pursued in motor car factories?

The opinion is sometimes expressed that investigations into the history of industry is wasted labour. With that view we cannot agree. As much that is of direct value to mankind may surely be learned from the study of those mechanical processes which have added to the fullness of life as from political, ecclesiastical, and judicial histories, or from the histories of art and philosophy. Whilst it may be open to grave doubt that "history repeats itself," yet it remains true that we cannot judge the present without a complete knowledge of the past. It is impossible to take any industry and arrive at a correct opinion upon its present position without a full understanding of how that position has been attained. Still further, is it impossible to make changes in any industry without paying due attention to its past? It may be said with certainty that if any man, knowing nothing and refusing to know anything of the tradition behind an industry, attempted to revolutionise it he would involve it and himself in disaster. It is as true of industries as of men that they are "all that they have been," and, consequently, that the more we know of their past the better we shall understand their present.

Institution of Mechanical Engineers.

SUMMER MEETING AT BIRMINGHAM.

The Summer Meeting of the Institution of Mechanical Engineers was held in the Central Technical College, Birmingham, on Tuesday, when the delegates, numbering some 350, from all part sof the country were welcomed by the Lord Mayor of Birmingham, Alderman A. H. James. It was his very great privilege, he said, on behalf of the citizens of Birmingham to extend to the members of the Institution a hearty welcome to the city. It was singularly appropriate that they should have chosen Birmingham for their meeting, for Birmingham could lay claim to be the metropolis of the engineering world. Although there were something like 1200 industries In Birmingham, engineering in its different phases might still be regarded as the staple trade of the city. The choice was, moreover, all the more appropriate having regard to the associations of the Institution with Birmingham in the years gone by. It was interesting to recall that the Institution was founded in Birmingham, and sprang from a very small beginning. in 1847 some tests were being made on a very steep incline near Blackwell to ascertain the power of locomotives, and it was at that gathering of engineers that the idea to form an institution had its birth. After a time, some few months, he believed, a meeting was held in the Queen's Hotel, and George Stephenson was elected the first President of the Association which was then formed. The first home of the Institution was still in existence, and those interested in historical associations would find it at the corner of Great Charles-street.

He had, he continued, referred to Birmingham as the metropolis of the engineering world, and when those present had visited some of the large engineering establishments in the neighbourhood, he thought that they would agree that they were second to none in any part of the country. He wished the Institution every success and hoped that it would continue to make progress. It was now seventeen years—1910—since it first held its Summer Meeting in Birmingham, and it was his late predecessor, Sir Wm. Bowater, who then welcomed them on behalf of the city. In conclusion, he hoped they would carry away with them many happy recollections of their visit, and that it would not be seventeen years before they had the pleasure of again welcoming them to the city. Their President, Sir Henry Fowler, was doubly welcome. In the engineering world he had established a name and fame that attracted great attention, while his personality commanded respect and admiration. He hoped that his period of office would be a very prosperous one.

Sir Henry Fowler thanked the Lord Mayor for his cordial welcome. He pointed out that it was eighty years since the Institution started under George Stephenson. It was forty years since he—Sir Henry—left Birmingham, after receiving one of the best technical trainings it was then possible to receive in the industry, and commenced the bread-and-butter side of his education. He hoped the Institution felt as much pleasure in returning to its old home in Birmingham as he did. In 1847, it was interesting to recall, the membership of the Institution was about 170, and in 1877 it had risen to 1000. Since then it had multiplied ten-fold, having a membership at date exceeding 10,000, and it was still growing. The Institution was deeply indebted to those engineers in Birmingham who gave to it their interest in its early days, and provided it with the opportunity to grow to the important body it had since become.

Speaking of the city of Birmingham, Sir Henry said that he thought that the city with its 1200 industries had a wider interest in engineering than any other city in the Empire. Its interests were so wide that it had been a matter of difficulty for the Reception Committee to decide which works to invite the delegates to visit. It was certain that were their stay very much longer, they could still find ample establishments of technical interest to inspect.

Mr. H. Kerr Thomas, of the Bean Motor Works, Dudley, a member of the Institution, then read a paper, entitled "The Effects of the Automobile Industry on the Midlands," which we reprint on other pages.

Sir Henry Fowler proposed a vote of thanks to Mr. Kerr Thomas for the very comprehensive and interesting paper he had read. It was one that could be referred to again and again. The author had covered the ground very fully and had given them reason to think very strongly on the effect which one industry, started in a small way, had had on the engineering profession as a whole.

Sir J. A. F. Aspinall, who opened the discussion, said that Mr. Kerr in his paper had stated that in 1896 the motor industry came to the fore. He would like to ask him whether any firm in this country

actually turned out motor cars in that year? He was under the impression that 1897 was the year the first motor car was produced in this country. He recalled that it was in that year that the proprietors of THE ENGINEER newspaper, in order to encourage the manufacture of self-propelled vehicles, offered prizes to the value of eleven hundred guineas for the makers of the first efficient motor vehicle. He and two others—the late Sir Frederick Bramwell and Dr. John Hopkinson—were appointed judges, and they had the greatest difficulty in getting anyone to compete. However, after many months they got a number of entrants. The trials took place in the grounds of the Crystal Palace and lasted two days, but as none of the entrants came out of the tests to the judges' satisfaction, they had to advise the donors that they could not recommend the awarding of the prize. With reference to the author's statement that there were in 1925 250,000 mechanics employed in the motor engineering industry, he would like to point out that those workers were one of the greatest products of the motor factories. A very large proportion of them were skilled men, and it seemed to him a great thing that so many men should have learned, in so short a time, to work with the skill and accuracy which the production of cars necessitated. In that respect, the motor car industry had educated people in the knowledge of what could be done and how it could be done. Engineers would now have to turn their attention to improving garage accommodation. When one remembered the enormous number of motor cars there were in this country to-day, something like 1,242,000, equivalent to 8·5 cars to every mile of road in England, Scotland and Wales, one was reminded of the enormous space they occupied, and the garaging accommodation they required. With 3000 cars of British make being turned out every week, apart from imported vehicles, they were adding enormously to the congestion and to the problem of finding accommodation, and as manufacture increased, the difficulties of the present position must become intensified. In a great city it was necessary that cars should be garaged near a man's business, and that meant occupying costly ground. The future garage, he suggested, should be constructed not unlike a locomotive shop. Assume that they had a very long garage with a clear space in the centre and an electric "traveller" overhead. For every car in the store they had a cage. They could run their car into the garage and into the cage; the "traveller" would lift it up and move it into position, either left or right, again leaving the centre free. In that way they would get perfect rapidity of handling. They could have a building of four or five floors, with a flat roof, and in that manner they would be able to store an enormous number of cars in a very small space.

Dr. Hele-Shaw said that the paper came at a most important and very serious time in the history of engineering in this country, for engineers had to take a very important part in reducing the terrible burden of unemployment. When they realised that at the present time 40 million pounds per annum were being paid in wages in what was comparatively a new industry, they must see that they were already playing a very important part in this matter. Sir John Aspinall had spoken of the number of cars to the mile in this country. There was another aspect to which he would like to call their attention. It was regarding the export trade and trade with our great Empire. We had allowed great rivals—he would especially mention the United States—to absorb a large part of that trade. We should do more to foster it. Already a great change was taking place, especially in Australia, from where, owing to the achievement of a Bean car made with Hadfield steel—it had crossed that difficult and rough country without a single stop for repairs—an increased call for cars of British production had been received. South Africa had been neglected. Germany had been supplying her with an enormous number of cars, and we had only just awakened to the fact that South Africa was a portion of the British Empire, and that we should be supplying her needs. He would point out, however, that it was useless trying to capture the colonial markets with cars made for British roads. They must remember the rough country they would have to traverse, and all the material they used should be specially tested to stand the great stresses which would be put upon it. They could not afford to send to the Colonies a car made from anything but the best materials, and of the best workmanship. Speaking of the Institution of Mechanical Engineers and its association with automobile engineering, Dr. Hele-Shaw said they had always given as engineers and as an Institution their encouragement to the industry, and they claimed a part of its success. Turning to the question of ball bearings, he said that it was surprising the number that were used by the motor car industry. He was pleased to be able to tell them that at last, as a result of much labour, the standardisation of ball bearing was in sight, for at a recent meeting in Stockholm all the makers of ball bearings had agreed to one standard.

Mr. George Lanchester supplemented the author's paper with a few historic facts relating to his brother's connection with the industry in its early days, especially regarding magneto ignition and roller bearings. There was one point on which he joined issue with the author. In his paper he stated that the motor car "speedily appealed to the popular imagination. No sooner was the invention made known than there grew a sudden and insistent demand for the supply of motor cars." His experience was that the demand was not insistent. Further, he recalled how, when he drove his first car, he had the greatest difficulty in finding a place where they would take in "one of those noisy, stinking things."

Mr. H. F. L. Orcutt remarked that it was curious how the automobile trade had become merged into the general engineering trade, and he hoped it would result in a greater union between it and the Institution.

Mr. L. A. Legros spoke of the advent of roller bearings and said that at the centenary of Watt there was shown a number of drawings, amongst which was one of a roller bearing made by Watt. Ball bearings to-day, he said, were made almost automatically. Little skill was required from the workers. All they had to do was to feed bars into the machine and out came bearings. Skill was not to be found in working the machine, but in producing the machine. Ball bearings were manufactured with a great degree of accuracy. A cycle ball, for instance, should be accurate to a ten thousandth part of an inch. Such accuracy was, however, due to machinery and not to operatives. Dr. Hele Shaw had pointed out that they were not developing the colonial markets as they should. He was of opinion that manufacturers were sending out the wrong men. They did not want to send abroad commercial men to sell the machine, but technical men to find out what was wanted of a machine, to return and produce it. The car would then sell itself. With reference to the author's statement regarding machine tools, "that Birmingham was not slow to respond to the demands of a new industry," he was inclined to differ As a matter of fact in some respects it was very slow in responding. He was inclined to the opinion that the impetus was due to the machines the Americans sent into the country to help out the British industry, and not to the response of the machine tool makers. The machine tool industry, nevertheless, was a very important one, though it did not allow of a very spectacular effect in finances. It was prevented by lack of capital from progressing as it would like. Many motor car makers had desired to go in for gear cutting, but the funds for the very expensive machines, which had to be of great accuracy and delicacy, were not available. What machine tool makers wanted was an endowment of half a million pounds to enable them to develop gear cutting machines. More attention should be given to this important and essential department of the engineering industry, for they ought not to have to depend upon America, which largely supplied them with gear-cutting and similar machines.

Mr. T. Lockwood Bunce spoke of the quality of skill required in most of the departments of automobile work and considered it almost non-existent. They did not require skill to work most of their machines, and what they should concentrate upon was the throwing out of obsolete machinery and the replacing of it with up-to-date plant that could be worked with unskilled labour. The apprenticeship system was at an end. They would never get real skilled apprentices coming as men into their shops, and they must therefore look to their machinery to supply the skill the operatives were once responsible for.

Mr. Chas. V. A. Ely remarked with regard to the history of automobile engineering in this country that, in 1893, an exhibition of motor cars was held in Tunbridge Wells. There were six cars in the exhibition, but none of them of British manufacture.

Professor P. M. Baker urged that the Institution should officially keep its eye upon the question of the provision of skilled men and the training of the younger generation. Throughout the engineering industry, he said, the skilled man was being replaced by the accurate tool and the really skilled man was rapidly dying out. They would, however, always require a supply of skilled men of the highest type, and they should bear that in mind and utilise the very best methods of training for their young men.

Lieut.-Colonel Davidson, D.S.O., R.E., who pointed out that the Army authorities were interested in the carrying vehicles and heavy side of the motor industry, urged makers to pay special attention to vehicles suitable for withstanding the severe tests which colonial conditions required. It was machines which could stand the rough country and the hard travelling of the colonial wilds that the Army authorities were interested in. He referred briefly to the tremendously improved conditions under which operatives worked to-day. He thought the Birmingham industries deserved a great deal of credit in that matter.

Mr. W. H. Patchell suggested, with regard to the garaging of cars and the economising of space, that motor car makers, like cycle makers in the past, might consider the advisability of building their cars so that they could be parked on end.

Mr. Kerr Thomas, in replying to the discussion, said that Sir John Aspinall's suggestion as to garages was of interest. It was a matter which would have to be seriously tackled before long. Congestion was becoming very bad in Birmingham, as elsewhere, and necessity would sooner or later arise for some such a scheme as had been suggested that day.

In the afternoon members divided themselves into parties to visit various works in and around the city and also the University.

In the evening the members gathered together at dinner at the Grand Hotel, Birmingham, under the presidency of Sir Henry Fowler.

Mr. Richard W. Allen, vice-president, in submitting the toast of "The City of Birmingham," returned thanks for the extraordinarily warm reception Birmingham had given them. The success of a summer meeting depended largely upon the send-off, and that had been such that the success of the gathering was assured. He hoped sincerely that engineering prosperity had come to the city of Birmingham. As engineers they could not progress unless there was prosperity around them, and they all hoped that Birmingham would continue to prosper with an even greater ratio than in the past. When they considered the number of people employed in engineering in the city and the destiny of the wives and children of those employees who were all dependent upon the prosperity of the industry, they could not help but trust that prosperity, health and happiness might come to all those engaged in the great city of Birmingham. Employers were all interested in the welfare of the people they employed. It was very easy to criticise and for people to say that employers did not take any interest in the welfare of their employees, but it was all rubbish. There never had been a time when the employers of this country—and he spoke nationally—had taken as much interest in the welfare of their workers as they did to-day. He appealed for goodwill between employers and employees, by which means difficulties would be the more easily overcome to the benefit of each. In respect of their treatment of their workers he knew of no finer body of men than the employers of labour in the Birmingham district.

In responding to the toast, the Bishop of Birmingham spoke at length of the urgent need for preventing the rapid increase in inferior human stocks, and expressed the hope that the nation might find some type of effective legislation which would prevent the present rapid increase of inferior stocks and give us citizens of whom Britain might be proud.

Alderman Sir A. David Brooks, who also replied, said that he regretted that the real craftsman who designed an article and made it with his own hands was rapidly disappearing. The great mechanical means now adopted in manufacture were a necessity of the age.

Sir Edward M. Iliffe, submitting the toast of "The Institution of Mechanical Engineers," said that the prosperity of the country and the Empire was due to the mechanical genius of the people which had been encouraged and developed by the Institution.

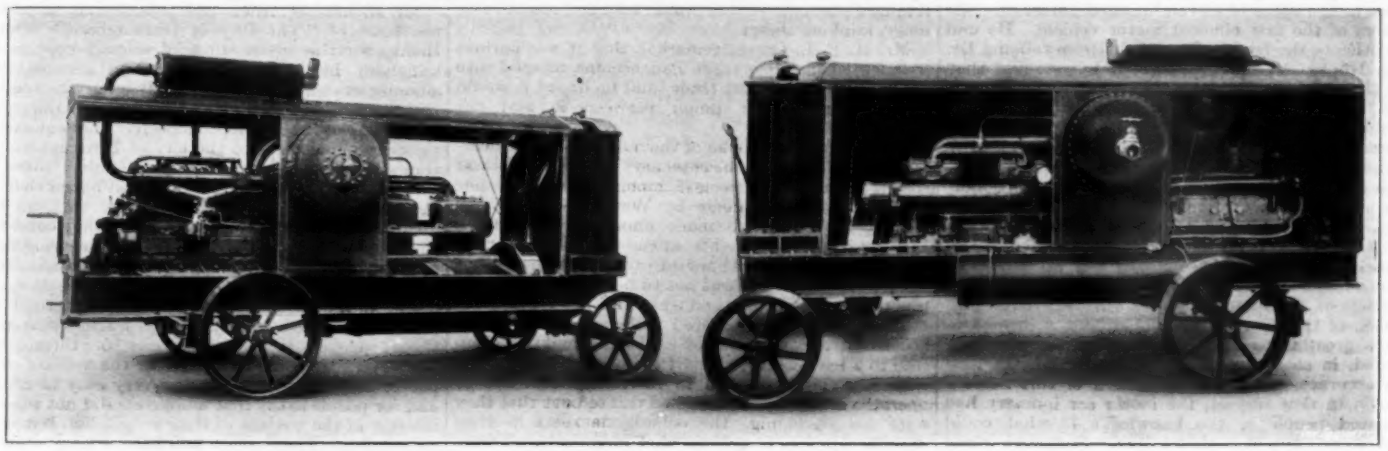
Sir Henry Fowler, replying, spoke of the ideals of the Institution. The future of civilisation, he said, lay with the engineer.

SIXTY YEARS AGO.

THE relationship of trades unions to the law was, as it is to-day, a subject of active debate sixty years ago. The unions were still illegal bodies, but there were many besides ourselves who favoured their recognition as provident societies for the relief of members thrown out of work by sickness or other cause: As bodies claiming the right to regulate wages, we regarded them as transgressing their legitimate objects, but on this score we did not take serious objection to their activities. We admitted the right of men not to work unless they received a certain recompense for their toil and to remain idle as long as they pleased or as long as they could find others to supply them with the comforts and necessaries of life. But events had taken place in Sheffield which showed that the unions were prepared to go to extreme lengths to tyrannise workers who did not see fit to join their ranks, and in other ways to act in a manner for which we could find nothing but condemnation. Writing on the subject in our issue of June 28th, 1867, we held it to be unnecessary to stain our pages with details of the crimes committed over a period of ten years by Broadhead and his accomplices among the Sheffield grinders. The tale of horror told to the Sheffield Commission more than confirmed, so we wrote, the worst accusations ever brought against the trades union system. In the endeavour to force unwilling recruits into the union deeds had been done and crimes committed, and a great centre of English industry had undergone a disgrace which it was almost vain to hope that time would efface. These words would appear to have been merited, and not to be merely an exaggerated expression of the mid-Victorian outlook on industrial relations. Actual violence and murder had been committed. Men had been blown up or shot for no worse offence than that they employed more apprentices than the union permitted, because they worked longer hours than the union's standard, or refused to submit themselves to the union's tyrannical rule. There had, too, been retaliation by the non-unionists, who had visited their brethren of the union with fire and sword in order to extort from them funds to maintain in idleness men whom the union would not permit to seek for work. The case of the Sheffield grinders, it was pointed out, was exceptional only in so far as the union could command the services of a Broadhead and a Clarke to enforce its rules. Other unions had laws no less severe, unjust and obnoxious, but they differed in the means employed to give effect to them. The greatest boon ever bestowed on the working man would, we said, be the passing of legislation that would remove the control of the unions from the hands of the small despotic minorities governing them from the centre, and commanding obedience because they held the funds. One step towards that end would, we argued, be to make a man at liberty to resign his membership of a union without forfeiting all the money he had deposited with it to meet times of sickness and distress.

PORTABLE SELF-CONTAINED AIR COMPRESSOR

BROOM AND WADE LTD., HIGH WYCOMBE, ENGINEERS



A New Portable Air Compressor.

A PORTABLE air compressor plant which is claimed to be one of the largest plants of its type yet built in this country, and which embodies several novel features, has recently been supplied to a Government Department by Broom and Wade, Ltd., of High Wycombe. It is illustrated in the accompanying engravings, and, when on service, it is entirely enclosed in a sheet iron casting, which, in the half-tone views, has been removed in order to show the machinery.

The plant comprises, first of all, a four-cylinder air compressor, with cylinders having a bore of 7in. and a stroke of 8in., which, at a speed of 445 r.p.m., deliver 275 cubic feet of free air per minute at a working pressure of 100 lb. per square inch. It is fitted with the firm's "Typhoon" type gearing, which consists of double helical gears, cut by the Power Plant Company, Ltd., of West Drayton, running in Hyatt roller bearings, and which brings about a speed reduction of about 2·6 to 1. The compressor has forced lubrication to every bearing, which is effected by a chain-driven oil pump arranged below the oil level, the oil passing through a large filter on its way to the pump. The air inlet valves are of the firm's patented mechanically-operated type, as shown in the drawing, while the delivery valves are of the thin plate type. Between the compressor and the engine there is an automatic centrifugal clutch consisting of two cast iron shoes, pivoted on excentric pins for the purpose of adjustment, and held in position clear of the clutch casing at low speeds by means of two springs. This clutch is designed to enable the engine to be started up light, and automatically and smoothly to take up the load as the engine gathers speed, and is claimed to be a great improvement on a hand-operated clutch which would throw the load on suddenly and subject the gears and crank shaft to severe stresses. It is of simple construction and its linings are faced with Ferodo.

The engine, which was made by the Aster Engineering Company, Ltd., of Wembley, is of the four-cylinder, four-cycle petrol type. Its cylinders are cast in two blocks and are fitted with detachable cylinder heads, the valves being of the side-by-side pattern, and operated from a cam shaft running along the front of the engine. The bore of the cylinders is 140 mm. and the stroke 150 mm., and the engine is designed to develop 65 brake horse-power at a speed of 1150 r.p.m. It has a half-compression device to facilitate starting, and an impulse starter is also fitted to the magneto. The starting, we are informed, is effected without the necessity for swinging, a few pulls-up only being required.

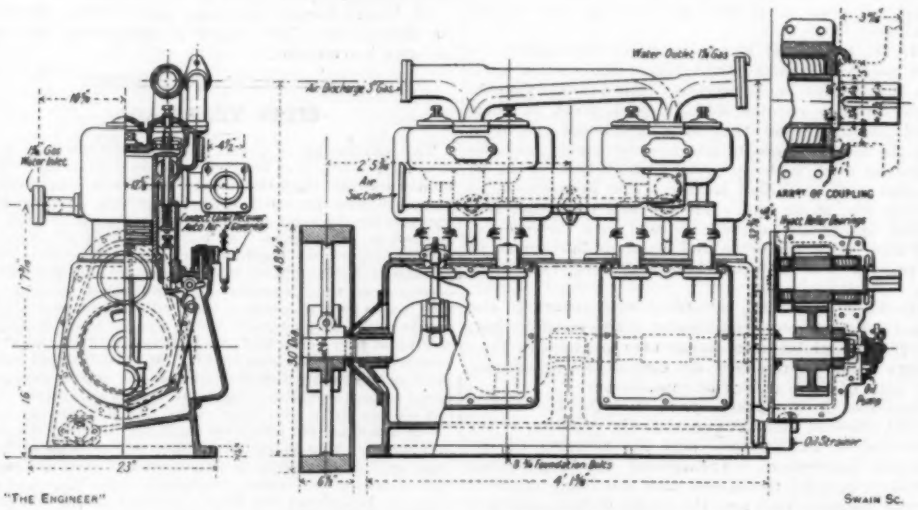
The engine throttle is equipped with a centrifugal governor that is adjustable by means of a spring which enables the speed of the plant to be reduced if full output is not required. A simple automatic air governor is also fitted to the compressor. It operates by admitting compressed air to four small cylinders, which lift the suction valves from their seats and entirely unload the machine, without creating a vacuum on the top of the pistons, and, hence, drawing oil up into the cylinders. This governor is also coupled to a small cylinder fitted with a plunger, which operates on an arm of the engine throttle. When the compressor is unloading, this small cylinder also closes the engine throttle, and reduces the speed of the plant to about one-quarter of full load speed, which effects a considerable economy in petrol consumption.

A large petrol tank is fixed at one side of the set, and the petrol is lifted to the level of the carburetter by means of an "Autovac" attached to the engine.

For the cooling system there are two large radiators, made by the Reliance Manufacturing Company, of Manchester. They are of very rigid type, and are equipped with a large-diameter fan which is driven by a whittle belt from the compressor crank shaft. A pump of the gear type circulates the cooling water first through the jackets of the compressor cylinders and then through those of the engine cylinders.

A riveted air receiver is, as will be observed in the illustrations, carried horizontally across the centre of the set, and the plant is protected from the weather by a sheet metal canopy, as well as being provided, as intimated above, with detachable sides.

We are informed that this plant, which has to undergo searching tests before it left the works at High Wycombe, is now operating in a very satisfactory manner on the work for which it was intended.



ARRANGEMENT OF AIR COMPRESSOR

The Internal Combustion Boiler.

A PAPER on "The Internal Combustion Boiler—Brunler Flame," was recently read before the Society of Engineers by Mr. Oscar Brunler. The author dealt with the internal combustion boiler and the various applications of flames, submerged in water, for industrial purposes. Discussing first the principle of burning a gaseous fuel in water or other liquid, he said that any kind of fuel would burn in water so long as the quantity of air or oxygen was large enough to support combustion. Considering the question of steam production for power purposes, he proceeded to point out that the efficiency of steam engine plants could be considerably improved by utilising the steam gas produced in internal combustion boilers. The net energy obtained per pound of residue oil burnt in water amounted to 1·9 H.P. hours, whereas the modern turbine locomotive produced 1 H.P. hour, with the same quantity of fuel. After discussing the question of power for the combustion air, the application of submerged flames for concentration purposes was next alluded to. Submerged flames could, it was pointed out, be advantageously employed for the concentration of acids, waste liquors, and for the dehydration of sewage sludge. The latter was a most important subject and test figures of dehydrating sludge by means of submerged flames were given. For the dehydration of 1 ton of sludge from 98 to 60 per cent. water content, 150 lb. of residue oil was used and 3700 lb. of steam gas was produced. Deducting the power used for the combustion air, a net power of 189 H.P. hours per ton of sludge was available for other purposes. The author advocated the dehydration of the sludge and its enrichment with nitrogen. In that case the sludge would become a useful and valuable fertiliser which could be sold with a considerable profit as agricultural manure.

The next point dealt with was the manufacture of nitric acid by means of submerged flames. The manufacture of nitric acid on a commercial scale had, the author explained, been fully investigated, and the method by which nitric acid was produced was as follows:—

The combustion air was enriched with oxygen so as to contain 45 to 50 per cent. of oxygen. In consequence of the reduced quantity of nitrogen in the combustion air, the flame temperature was increased to over 2200 deg. Cent. The rapid drop of temperature which took place between the flame and the water produced nitric acid as well as nitrous vapours. The quantity of nitric acid produced depended on the pressure in the boiler. It had been found that the quantity increased on increasing the boiler pressures. At 225 lb. per square inch pressure, the output of nitric acid amounted to 25 per cent. of the weight of the combustible mixture, *i.e.*, 1000 lb. of fuel plus enriched air produce 250 lb. of nitric acid.

The author then proceeded to deal with the interatomic theory and the question of internal combustion boiler efficiencies. An account of the constitution of matter, of the emanation of electrons and ions, and of ionic energy was given. The author stated that nowhere else, not even in the disintegration of radium, was a dissolution so rapid, and that nowhere else did an emantion of electrons in such enormous quantities take place as in the hot gases of a flame. He also stated that the utilisation of that radiant energy, *i.e.*, the interception of electrons and their utilisation, was possible. According to the law of the conservation of energy, the energy invested in the electrons could not be annihilated. He maintained that water, even in thin layers, stopped the electrons in their travel, and the water became decomposed into its component parts—hydrogen and oxygen—which were produced in direct contact with the flame, ignited and recombined again. The correct employment of flames burning in water was, he added, a means of making useful a source of energy little known up till now.

Cost of Noise.

AN extensive report by Professor Spooner on the Progress of the Movement for the Reduction or Prevention of Harmful Noise was submitted to the International Fatigue Committee of the American Society of Industrial Engineers at the National Convention at Chicago on May 26th, 1927. Professor George H. Shepard, of Purdue University, presided.

This report, the sixth the author has written for the Committee since he joined it in 1912, is based on his investigations and experience in dealing with noise problems during the past ten years; and these have led him to form the following definite opinions:—

The fatiguing effects of noise in all our activities is the most neglected aspect of the science of fatigue.

The prevention or reduction of noise in commercial and industrial work is a paying proposition.

That mental work done in a noisy distracting atmosphere sooner or later leads to nervous complaints, and tends to lower efficiency and output.

There is a growing revolt in all civilised countries against the tyranny of noise in the streets, in the work-place and in the home.

That the mechanical uproar of tramway cars is the most nerve-shattering noise in our streets, and as these noisy

vehicles are often held up and cannot compete with the more efficient motor bus, they are being gradually scrapped or made trackless. In fact, since the introduction of motor buses they have lost most of the reasons for their existence, and are doomed to ultimate extinction.

Tube railways are notorious for their distressing din; indeed, it is a wonder that their awful noise is so patiently tolerated. The primary causes of the trouble should be tackled; it is little use tinkering with the secondary ones.

That worn ramshackle noisy motor vehicles should be warned off the streets by the authorities, to be reconditioned or scrapped. This policy would also be in the true spirit of economy.

That horns or hooters should be standardised as to pitch; and that a low melodious note should be adopted; that driving-on-the-hoot should be prohibited; and that Klaxtons and the like should only be used in cases of emergency.

That the use of the nerve-racking pneumatic rock drills for breaking up roads, &c., should not be permitted in the streets of towns; certainly not in the vicinity of hospitals, nursing homes and schools.

That noisy machinery means abnormal wear and waste of power. The noise also tending to reduce the productive powers of the workers, and may, through nervous strain, be a possible cause of accidents. In short, noise is one of the heaviest overhead costs in modern business.

Designers and constructors of machinery must pay more attention to the balancing of rotating parts, particularly high-speed ones, and to the mounting of certain machinery on anti-vibration supports. There is wide scope for genius in dealing with noisy processes.

That the noisy surroundings of countless hospitals, nursing homes, colleges and schools is a serious matter calling for earnest attention.

That the alarming depreciation in the value of house property and land on or near the hundreds of miles of noisy main traffic routes in this country must amount to an appalling figure, and therefore calls for serious attention.

The most serious aspect of the noise problem, one that has received no attention, is the enormous loss due to impairment of working capacity and efficiency in city and industrial life; more particularly as to men of affairs, principals and executives, whose capacity for clear thinking, hard work, and energetic action is, without doubt, perceptibly weakened by the incessant if unconscious strain upon their nervous systems caused by the din of typewriters and adding machines, and by the babel of noise penetrating their offices from outside. In the aggregate, the economic loss due to this kind of wastage must be staggering in amount; indeed, it could conceivably be a great deal over £1,000,000 a week in this country alone. But the loss due to ill-health and premature death cannot possibly be estimated.

The authorities responsible for the nation's health in all countries have apparently been strangely neglectful where harmful noise is concerned; and nothing worth mentioning has been done in any country by the authorities to protect the nervous health of the people in this respect. There is a wide field unexplored awaiting organised activities of engineers and medical men. But when shall we awake to the folly of its neglect?

A 165 K.W. Oil Engine Driven Generator Set.

WE recently inspected under running conditions at the maker's works two sets of marine auxiliary oil engine driven generator sets, which have been constructed by Ruston and Hornsby, Ltd., of Lincoln. They are part of nine engines of the type which are now under construction and are to be supplied to the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, Glasgow, for installation on a motor vessel belonging to the Houlder Line, which is now being built at the Fairfield yard.

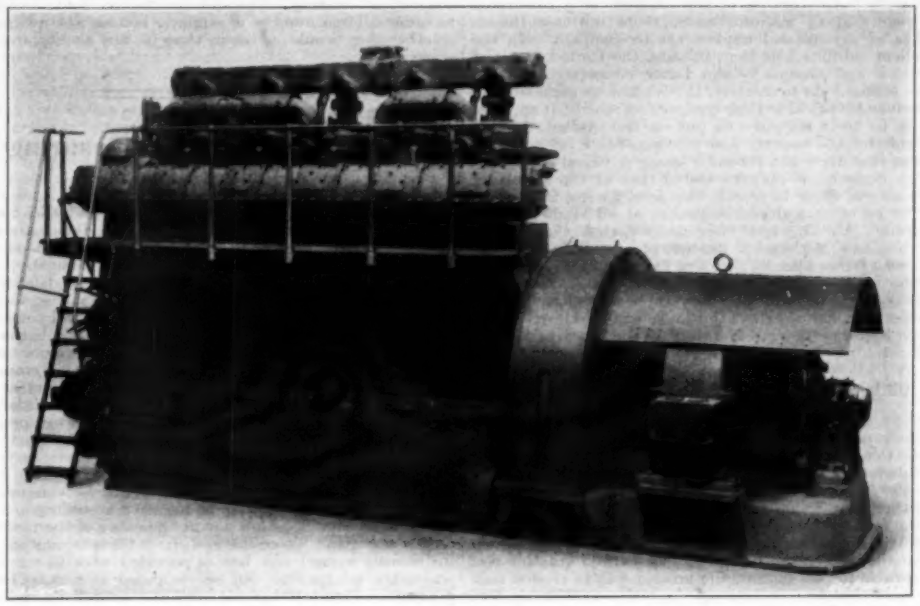
The view given above shows the general arrangement of the set. The engine is of the four-cycle airless injection type and has five cylinders, each with a bore of 12in. and a stroke of 17½in. It is designed for a very moderate rated output of about 250 B.H.P. when running at a speed of 300 r.p.m., and is coupled to a 165 kW 220-volt generator built by the General Electric Company, Ltd., of Witton. From our illustration it will be seen that the dynamo is mounted on a substantial bed-plate which is bolted to the main bed-plate. The same width is retained for the two bed-plates and for that reason the portions of the dynamo bed-plate which carry the fly-wheel cover and the magnet frames are slightly overhung. A light metal shield is carried over the top of the generator in accordance with the usual marine practice.

Although in the main the engine does not widely depart from standard Ruston practice, we noted several interesting points in the design. The bed-plate of the engine is of the box pattern and is strongly ribbed. It contains a very deep lubricating oil sump at the pump end, which is fitted with baffles so that the lubricating oil pump suction is always covered, even although the bed-plate should depart slightly from the level owing to the movement of the ship. At the bottom of the bed-plate sump, below the centre of each cylinder, two special fulcrum pieces are cast in order to facilitate the removal of the connecting-rod and piston to be referred to later on. The crank shaft is drilled for forced lubrication, which system is also extended to the crank pin and gudgeon pin bearings. As with five cylinders there is an unbalanced couple, balance weights are fitted to the two outer crank cheeks, one at either end of the engine.

A monobloc crank case is employed into which the cylinder jackets and liners are inserted. The lower part of the jacket and the liner can clearly be seen in our second illustration, which shows the large size of the inspection doors. That view also shows the two-part 12in. diameter piston, the skirt of which is drawn forward on its rod and is ready for lifting out. Part of the piston head is seen projecting below the liner. It carries seven piston rings and is secured to the skirt by four through-going bolts, the heads of which are housed in recesses in the piston skirt; one of these recesses is seen to the right of the skirt. Passing reference may be made to the stepped

165 K.W. MARINE AUXILIARY OIL ENGINE GENERATOR SET

RUSTON AND HORNSBY LTD., LINCOLN, ENGINEERS



METHOD OF WITHDRAWING PISTON

type of bearing for the floating gudgeon pin, which gives maximum bearing surface on the top side of the piston bearing and the underside of connecting-rod top end bearing.

For the dismantling operation a patented design of double fulcrumed cradle is employed, and while the lower part of the piston is removed the upper part is held in place by a long bolt passed through the atomiser aperture and screwed into the piston crown. The view shown below also gives some idea of the comparative ease with which all the reciprocating parts can be inspected. For use while the engine is running a small circular removable cover is fitted to the main door.

A cast iron cylinder cover is bolted to the water jacket casting and in the larger sizes of engine a cast steel lower flange is fitted to the cylinder cover. The valve gear is of the standard Ruston type with horiztontally arranged air inlet and exhaust valves, the former being placed at the front and the latter at the back of the engine. At the back of the cover to the right a combined air starting and compression relief valve is fitted on each cylinder. The fuel atomising valve is a vertical valve placed in the centre of the cylinder cover.

The valve gear is driven from the crank shaft by a neatly arranged and totally enclosed skew gear drive at the left-hand end of the engine. This arrangement also provides for a direct spur gear drive for the two fuel pumps and an undertype worm drive for the water circulating and forced lubrication pumps. The pumps draw their supply of oil from the sump through duplicate vertical filters fitted with a change-over valve so that either filter can be cleaned while the engine is running. The filters are arranged at the back of the engine and a Serck oil cooler is fitted at the end of the bed-plate. The circulating water pump, which is of the two-stage centrifugal type, will be seen above near the left-hand end of the engine, and a cooler is also provided. Near to it is a hand priming pump for the lubricating system. We may remark on the totally enclosed cam shaft casing. The shaft runs in oil and the casing also carries the valve operating levers which work the air inlet valves direct and the exhaust valves through push rods which are carried between the cylinders on the right of each cylinder. The cam shaft casing is provided with removable inspection doors. A platform which runs the full length of the engine gives access to the valve gear. Both the air inlet manifold and the exhaust manifold are arranged above the cylinder heads and the exhaust pipes are water jacketed. The cooling water leaving the cylinder jackets and covers passes into the exhaust manifold A regulating valve is provided above each cylinder.

Reference may be made to the starting and control arrangements. As already mentioned, a starting valve is fitted on each cylinder, which is of the automatic type. The compressed air which is hand controlled by a main valve placed near the starting platform passes to spring-controlled distributing valves mounted above the cam shaft and situated slightly to the right of each cylinder. When the air pressure depresses a cam tappet the starting air is delivered to the cylinder valve at the correct part of the stroke of each cylinder by timed cams. There is a hand lever at the left-hand end of the engine which controls the compression release valves, and another lever which may be utilised to cut off the supply of fuel to the atomiser valves. The fly-wheel is provided with spaced barring holes in which a hand barring lever is placed, a slot being provided in the fly-wheel cover, as shown above, for this purpose. There are two fuel pumps, which deliver the fuel to a distributor with a reciprocating plunger which is provided with ports for directing the fuel to each of the five atomisers in turn. A full account of this fuel oil distributing gear will be found in our issue of June 11th, 1926.

The generator set we have described appeared to run very quietly, and it has already undergone extensive and successful bench tests. In a continuous trial extending over the whole of one week an average fuel consumption of 0·61 lb. of oil per kilowatt-hour was attained. Engines of the type we have described are now made by the firm in three-cylinder units up to a total output of 150 B.H.P. for marine propulsion purposes. For marine auxiliary sets of the type illustrated the sizes range from 30 kW three-cylinder units up to six-cylinder units of 500 kW capacity, the intermediate sizes being built as either three, four, five, or six-cylinder engines as required.

South African Engineering Notes.

Agricultural Machinery.

THE agricultural shows held in the Union are proving valuable in other ways than in encouraging the breeding of better stock and teaching farmers the importance of using fertilisers and good seed. They are educating them in the value of using agricultural machinery and implements of the most up-to-date and labour-saving character, together with cheapness in running. The importance of agricultural shows as educators in this respect is so well recognised now that these shows have become as much machinery exhibitions as agricultural shows, so great has the variety of power-driven appliances for farm use become during the past few years, and so large the space devoted to exhibits of these articles. Among the items in which the greatest interest is taken appear to be the numerous makes of petrol and crude oil engine driven electric light sets, ranging from 2 to 5 kW portable, semi-portable and stationary petrol and crude oil and steam engines, ranging from 2 to 24 B.H.P., tractors fitted with free engine and pulley, motor-driven spraying machines, fruit and flour-grading machines, threshing machines, aero-motors, power-driven ram and centrifugal pumps, cream

separators, &c. There are also, of course, the most modern plough cultivators, grain and seed drills, reapers and binders, and other agricultural implements of a similar class. As far as petrol, crude oil and steam engines are concerned, British makes are well represented, and are equal, and perhaps better, than the best foreign products, but with the exception of the exhibits of a celebrated Ipswich firm of manufacturers, there are few British makes of agricultural implements to compete with the excellent exhibits sent from Canada, the United States of America and Germany—the latter country is making great strides. As to tractors, British makers seem to have abandoned the field to their competitors mostly, it appears, owing to their inability to put on the market tractors suitable for the country and at competitive prices. This means that they are throwing away a valuable market. As an instance, it may be stated that at the Rosebank Agricultural Show in March, one firm, among the largest exhibitors of agricultural requisites of all kinds—mostly Canadian, U.S.A., and German—reported the sale of Deering and McCormick implements totalling in value £17,500. Other sales by the same firm included nine motor lorries, two industrial tractors, one thresher and seven binders, and, in addition, they estimated that at least another £20,000 worth of business will result from the many inquiries made. Nothing of this goes to English makers.

Oil in East Africa.

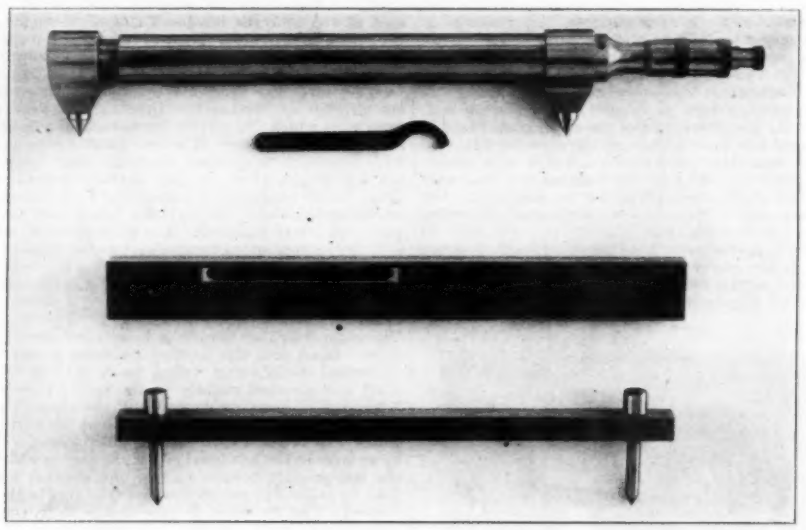
According to Mr. J. van Tijn, who was until recently oil geologist in the service of the Royal Dutch Shell Company, but joined the board of Inyaminga Petroleum, Ltd., nearly a year ago, the company's property at Inyaminga, Portuguese East Africa, where boring operations are going on as rapidly as possible, presents all the features favourable to the finding of oil. He states that oil has been found in Madagascar, but not in big quantities, the reason being that, while the formation was favourable for oil genesis, the ground was so eroded that the anticline was broken up, and the weathering had spoiled the oil, and various seepages were to be found all along the surface. In Mozambique, so far as known to-day, the condition for the formation of oil are as favourable as in Madagascar—being, in fact, a continuation—and there are also the conditions favourable for the accumulation and storage of the oil. They did not find there the anticline opened up, but all the big anticline was covered by an overlay of impervious strata, and there was every reason to believe that oil would be found there. In addition to this general geological theory, the expectation is borne out by the evidence disclosed by the bore-holes. In 95 per cent. of the oilfields of the world there is found one stratigraphical section, starting from coarse sands and gravel, then the gravel and sand get finer, and at depth shale levels are found with a change in the gravel formation, and in between the shale levels are finer sand lenses in which the oil is found. At Inyaminga most of these strata are present and boring must continue through the lower levels until the finer sand lenses are reached. There is, according to Mr. van Tijn, every reason to believe that if this process is continued oil will be found. He is, of course, unable to say how big the oil wells will be, but all the geological conditions which are necessary for the formation of oil are present at Inyaminga, and nowhere else in the sub-continent are the conditions for finding oil better than at Inyaminga, and therefore the results of the operations now in progress there can be looked forward to with high expectations. The oil is expected to occur in the upper and middle Jurassic, at present the drilling is in the upper and middle Cretaceous. The depth at which oil can be expected to be struck is probably between 3000ft. and 5000ft. Dr. Mennell, the company's consulting geologist, is in complete accord with Mr. van Tijn. So far, the geologists have only been able definitely to locate one anticline, but there are indications that other anticlinal formations may exist in the territory to the west of the Inyaminga structure. A further detailed examination of that area has therefore been decided upon, and a fully qualified assistant geologist, recommended by Professor Moiengraaff, has been engaged, and on arrival will at once proceed to Inyaminga to carry out a detailed survey of the said territory under the supervision of Mr. Mennell.

Heavier Train Loads.

In the course of a meeting between officers of the Union Railways Administration and representatives of the Locomotive Engineers' Mutual Aid Society, held recently, the general manager of railways, Sir William Hoy, stated that he hoped that shortly it would be possible to institute a service on the main line in Natal, which would carry a load of 3000 tons per train, using two units. He was fairly certain that the increased service would be so successful as still further considerably to relieve the congestion existing. The Administration had decided to order a large number of engines, but he was not sure whether they would arrive in time for the coming maize season.

A Strain Gauge for Measuring Deflections.

Our attention has been called by Buck and Hickman, Ltd., Whitechapel-road, London, E. 1, to a device known as the Howard strain gauge, which is now being made by the Brown and Sharpe Manufacturing Company, of Providence, for the purpose of measuring the deflection under load of bridge spans, girders, dams, and so forth. The device, illustrated herewith, is a bar micrometer adjustable to measure changes in any length between 10in. and 20in. It can deal with changes covering a total range up to four-thousandths of an inch—two-thousandths on each side of the zero—and reads to ten-thousandths of an inch. A straight steel bar fitted with two hardened punch points is provided wherewith to establish two points on the span to be measured when it is in its normal or unloaded condition. From the difference between the distance apart of these two points when the span is free and when it is loaded the deflection can be computed, the difference being positive or negative according as the points are situated to one side or the other of the neutral axis of the span. To ensure and check the accuracy of the instrument a steel test bar is provided with it, against which the micrometer can be compared at normal temperature. This test bar also serves to check the punch bar after the punches have been sharpened or ground. To measure the deflection of a loaded concrete structure the punch marks are made on two small metal plates previously let into the structure.



THE BROWN AND SHARPE STRAIN GAUGE FOR MEASURING DEFLECTIONS

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

DEVELOPMENT OF THE BRITISH STEAM LOCOMOTIVE.

Sir,—Readers of The Engineer are now, I imagine, more than ever interested in locomotive matters, after reading the fascinating serial article from the able pen of the late Mr. E. L. Ahrons—*vide* The Engineer, January to December, 1925. I think, therefore, it would be interesting if we were to forecast the probable lines on which development will take place during the next few years. On looking through some old numbers of The Engineer, I came across a forecast I made in your columns some twenty years ago, which has proved to be remarkably correct. I stated that "the British express passenger locomotive of the future would probably be of the six-coupled type with three or four simple cylinders, and would use superheated steam." It is interesting to note that each of the four big railways are at present building a number of such engines.

Now, what of the future? I picture the British express passenger locomotive as follows:—The design follows closely that of Mr. H. N. Gresley's famous "Pacific" 4–6–2 engine, in that it will have three simple cylinders, six-coupled wheels, and a wide fire-box type of boiler. It will, however, be modified in several important particulars. The fire-box will be lengthened about 18in. in order to provide a grate area of 50 square feet, and the trailing end of the engine will be carried on a four-wheeled bogie. This will be desirable, not only on account of the increased weight, but also to obtain sufficient flexibility for such a long engine. Thus, the wheel arrangement will be 4–6–4. Being a three-cylinder simple 120 deg. engine, the adhesion weight can safely be increased to 23 tons per axle, so that there will be a total adhesion of 69 tons. Steam pressure will be round about 250 lb. per square inch.

We shall no longer use one piston slide valve to serve the double purpose of admitting and releasing the steam to and from the cylinders. No. Our modern locomotive will have separate valves—probably of the poppet variety—for admission and exhaust. This will provide for a variable expansion and a constant exhaust, thus dealing a death-blow to a throttled exhaust when working at early cut-offs.

The steam dome will be dispensed with, and the regulator will be arranged on the superheater header in the smoke-box. Thus, the superheater elements will contain steam under all conditions of working, greatly to their advantage.

Increased tractive power will be the order of the future and this will be obtained in three ways:—

(1) Steam pressure will be increased, as already mentioned.
(2) Diameter of driving wheels will be reduced to 6ft. 6in.
(3) Piston stroke will be increased to 28in.

Naturally, this will mean an increase in piston speed, but that will be easily attainable in view of the high pressure of the steam and the free exhaust. It will also be advantageous from the thermal aspect.

Our hypothetical locomotive will be equipped with an efficient feed-water heater and pump, as this useful appliance will be perfected to such an extent as to warrant its adoption as standard practice, even as steam superheating is the standard practice of to-day.

This, then, is my conception of the British steam locomotive of the near future. It is certain that a real battle will be fought out between the three-cylinder and the four-cylinder types, and I predict an ultimate triumph for the three-cylinder locomotive on the score of all-round economy.

The type of locomotive I have suggested will give quick acceleration, and an ability to climb hills at a good speed; thus doing away with the need for very swift downhill rushes in order to keep to scheduled times. I trust I have not encroached too much on your valuable space.

Chas. W. Dauncey.

Birmingham, June 27th.

ENGINEERS AND POLITICS.

Sir,—It is but a short time since an event of considerable importance to engineers passed almost unrecorded. I refer to the virtual eclipse of what was known as the Engineers Bill, a Bill which aimed at State registration of engineers.

The purpose of this letter is not to discuss the origin of the Bill, nor to comment upon its provisions. I desire merely to record an observation which appears to merit the attention of all engineers, and particularly those who are members of the principal technical institutions.

In general, engineers are not politicians. This may be confirmed by reference to the "Who's Who" of any Parliament during recent times—certainly since the Great War. I refer exclusively to trained, technical engineers, not to the captains of industry with engineering interests, many of whom frequently do become prominent in politics. This state of affairs may have been hitherto neither surprising nor serious. Probably no circumstance has previously arisen in which the lack of direct representation of the profession as a whole in Parliament has been a phenomenon of any importance or even noticeable. Recent events in connection with the Engineers Bill, however, revealed a very definite weakness, almost a state of atrophy, in the political consciousness of the engineering profession.

The primary function of any of the leading engineering institutions has always been to promote the development of the science and practice of its particular branch of engineering. But these institutions should also constitute the medium through which a constant and efficient liaison is maintained between the profession and the public. In this instance, Parliament took the place of the public, and the introduction and progress of this Bill escaped the notice of all but the most vigilant of interested parties. Here was a measure of vital importance to all engineers being introduced to Parliament, and yet it was a matter of no little difficulty to find a few Members of Parliament who, if not engineers, were at least in direct touch with the profession and with technical institutions particularly, to undertake a watching brief on their behalf. Fortunately, there was one, not only an engineer by profession, but a member of Council of the parent engineering institution, who effectively voiced in Parliament the opinion of the institutions represented by the Engineering Joint Council.

In the House of Lords less difficulty would have arisen, because there the engineering institutions are well represented by several peers who are or have been directly associated with those institutions in a presidential capacity.

It is the House of Commons from which engineers are conspicuously absent. The leading technical institutions might with advantage consider the situation, seeing that it involves a serious restriction of their means of self-expression in matters which, like the Engineers Bill, concern both the profession and the public generally.

The Bill referred to may conceivably be re-introduced in a new form in the autumn, in which case the urgent need of political co-ordination of the institutions will again be emphasised. In a recent paper and discussion on technical *versus* non-technical management in industry, an overwhelming case was made out for the former. The need for a strong technical leaven in the parliamentary "lump" could be equally well established, and it should be for the technical institutions to find means of supplying that need.

It seems reasonable to suggest that when the Councils of these institutions nominate future Presidents, membership of Parliament might be considered a special qualification for the office, in view of the increasing inter-relation of industry and statecraft.

June 27th. Watchman.

A.S.L.I.B. DIRECTORY.

Sir,—May I be allowed through the medium of the Press to offer my thanks to all those who have kindly responded to my request for information in connection with the preparation of the Directory of Sources of Specialised Information, and at the same time beg those who could assist, but have not yet written to me, to do so at once, as we are fast approaching the close of our work? I should especially like to be able to include some more collections in the possession of private individuals.

G. F. Barwick, General Editor.

38, Bloomsbury-square,
London, W.C. 1, June 23rd.

The recommendations of the London and Home Counties Advisory Committee as to transit facilities in South-East London were noted in our issue of March 11th last. The Committee recommended the re-opening of Old Kent-road Station, but the Southern Railway has now told the Ministry of Transport that it does not see its way to comply with the recommendation.

The Effect of the Automobile Industry on the Midlands.*

By H. KERR THOMAS, Member.

I.

FEW who are familiar with the design of automobiles and their general methods of construction can have failed to notice how profoundly the development of the motor vehicle has affected the general practice of mechanical engineering throughout the world. More particularly is this apparent to those whose professional memories extend into the later years of the last century, and it may be of some interest, at this Birmingham gathering of mechanical engineers, to make a brief survey of the influence of automobile engineering upon the mechanical industries of the Midlands.

In the early 'nineties the development of the safety bicycle had resulted in the growth of a great industry to meet the popular demand for what must ever be regarded as a curious vehicle. The manufacture of cycles had, for no very definable reason, been concentrated in Coventry. Once the centre of a textile industry—the manufacture of silk ribbon—Coventry had embraced the art of watch-making and, as the older art declined, the population turned to the newer as a natural employment for workers to whom delicacy and precision of touch had become habitual.

James Starley, a Sussex man, who had been working as a gardener at Lewisham in Kent, and who was a natural mechanic and amateur watchmaker, had left his gardening and become an employee of a firm of sewing machine makers in London. Thence in 1857 he migrated with a few friends to Coventry and commenced the manufacture of sewing machines in the watchmaking city, this being the origin of the Coventry Machinists' Company. In 1868 he began to make bicycles after a French model and from this grew the cycle industry, which in the last five years of the nineteenth century had assumed considerable proportions. In 1895 Lanchester produced his first motor car, and in the same year a car designed by Austin was built by the Wolseley Sheep-shearing Machine Company. Thus was started in Birmingham the germ of the new industry which was later to have a far-reaching effect on the practice of mechanical engineering throughout the world.

By this time Coventry had come to be regarded as the natural centre of the manufacture of machines which were then the only means of mechanical road transport for passengers, and when in 1896 the first motor manufacturing company was formed it was only natural that Coventry should be selected for its habitation. It came about that the Daimler Company had its beginning in a disused silk mill, the city's newest industry thus literally rising from the ruins of its oldest, and from Coventry as a centre the motor industry has since spread through the surrounding district.

There is a curious psychology attendant on the practice of travelling in a motor vehicle, and it may be doubted whether any other invention has so speedily appealed to the popular imagination. We find that no sooner was the invention made known, through reports of what were then considered astonishing performances, than the public—or at least that section of the public who could afford the price—came forward with a sudden and insistent demand for the supply of motor cars. It was, in fact, only necessary for any enterprising mechanic to build a vehicle which would give some sort of performance for that vehicle to be sold. Motor cars at that time were built by adventurers in almost every town, and found a ready sale.

But by 1896 there were established factories with capital at their command, which had laid themselves out to build standardised vehicles and to market them. It happened that in Coventry the makers of bicycles had created some demand for machine tools of a more complex character than the older and more familiar tools of the machinist. There was an immediate demand at the time for cars which, although of small horse-power, were necessarily expensive luxuries, and manufacturers were not slow to perceive that if the price could be reduced a very much larger market could be captured; and it also became evident that if the production of similar parts could be accomplished on automatic or semi-automatic machine tools a considerable reduction in cost might be effected. So we find that in the last year of the nineteenth century machine tool makers were turning their attention to the development of every kind of device which would meet the demand for accurate multiple production.

Having been long renowned for the manufacture of machine tools, the district of which the city of Birmingham is the centre was not slow to respond to the demands of a new industry within its confines. The complexity of this new product with its multiplicity of gearing afforded scope for all manner of innovations in established practice, but an important fact must be noticed. In the early days of the automobile industry the demand for machine tools was too irregular to justify machine tool makers in manufacturing highly specialised machines in the limited quantity required, and so for a number of years machine tool designers proceeded on conservative lines, making only such special machines for the motor trade that they could dispose of in other markets. At the same time the demands of the motor trade were great enough to set the tool designers thinking, and radical changes were speedily made in the design of standard machine tools. It became the duty of the machine tool salesmen to push these machines in the ordinary machinery market, and thus commenced some twenty-five years ago a very noticeable change in machine shop practice which has now become stabilised.

II.

One of the first changes brought about by the automobile engineer was the general use in engineering practice of alloy steels (which will be referred to later); as a result machine tools had to be capable of working on much harder steel than had hitherto been the case, and this practice rapidly spread to other branches of engineering.

Amongst the machine tools to be developed for automobile work were boring machines. The early practice with automobile engines was to employ separate castings for each cylinder, and it was possible to machine these on the ordinary type of boring machine with a single horizontal spindle. Later, two cylinders in pairs became the rule, and a new type of boring machine had to be evolved employing two spindles which operated simultaneously. From that it was an easy transition to four cylinders in a single block, which were made, in France at any rate, as far back as twenty years ago. This necessitated the multiplication of spindles so that the four bores could be machined at once. Then came the six-cylinder monobloc, and it is now common practice to machine eight cylinders in line with eight boring spindles.

Motor cylinders are of relatively small size, and with improvements in tool steels, cutting can be accomplished rapidly, so that the accumulation of borings proceeds at a corresponding speed; the resulting *débris* in the cylinder presents difficulties of removal, and if allowed to remain, the particles of iron carried round by the cutters are liable to cause injury to the bore. A change in practice became possible when engine designers adopted the detachable cylinder head. When the cylinder bore became a plain parallel tube with open ends it was evident that by placing the casting upright and operating upon it with a vertical boring spindle the borings would fall out at the bottom and so cause no trouble. Hence resulted the evolution of the vertical multi-spindle boring machine, which is now in universal use for this purpose. Such machines as these have no general use in other branches of engineering, and a special line of machinery has therefore been produced, incorporating this feature of multiple boring.

Multiple drilling has been in existence for a long time, but the multiplicity of drills now employed would have astonished shop managers a generation ago. It is quite common practice now to find special drilling machines fitted with three or four separate multiple heads, each operating twenty or thirty drills, so that more than a hundred holes can be drilled simultaneously in one operation.

Mention has not yet been made of splined shafts. The author believes he is correct in stating that the first design for a multiple keyed shaft (now known as splined) was due to the ingenuity of Dr. Lanchester, and their production was standardised in the Lanchester works from their early days. The formation of a shaft with a solid key was unknown until the advent of the automobile. Loose keys were originally fitted into grooves provided for the purpose, but under conditions of vibration and high speed this practice soon proved inadequate. The first attempt to evade it—that of providing a square shaft—was unsatisfactory for many reasons, the chief difficulty being the tendency to burst on the part of a wheel so mounted. It was then discovered that it was possible by means of a milling operation to cut four or more keys solid with the shaft, and the problem then arose of cutting the corresponding keyways in the boss of the wheel.

The older practice of cutting the keyway by means of a slotting machine proved expensive and inaccurate; this antiquated method was superseded by the cutting of four, six, eight, or even twelve keyways in one operation by means of a drift or broach, and the earliest machines for accomplishing this were developed in the Lanchester works. The modern practice for cutting the splines of a shaft, which originated in a factory under the author's management, is to consider the shaft as a kind of gear wheel and to cut the splines by means of a hob, a method which gives exceedingly accurate indexing and is at the same time rapid in operation. The finishing of this complex section is now accomplished by grinding.

Another specialised operation is that of milling the cams which operate the valves of an internal combustion engine. The oldest practice was to cut individual cams in a milling machine, using two semi-circular cutters for the base and point of the cam. The feed of the cutter was in the direction of the longitudinal axis of the cam, and the flanks were finished with still another cutter. The modern way is to make the cams integral with the shaft and to mill each cam with a flat milling cutter rotating in the direction of the periphery of the cam; the cutter is caused to approach and recede from the cam while the cam shaft rotates, the precision movement of the cutter being regulated by a master cam on the machine. Machines for doing this, as well as those for grinding the finished cam after hardening, were first developed in this country and are now standard practice all over the world.

It is somewhat curious that the wide range of gear-cutting machines began, and has remained to a great extent, as the monopoly of French, German, Swiss or American manufacturers, and remarkable improvements in accuracy and speed have been effected in their design. The operation of finishing gears by grinding which was first practised in America has been perfected by a Birmingham firm which now deals with a very wide range of subjects, this most difficult and highly specialised operation having been placed upon a commercial basis.

Such machine tools as turret, capstan and automatic lathes are, of course, suitable to the general market, but one important maker in the Midland district has informed the author that the considerable output required by the automobile industry, coupled with the high grade of steel on which operations have to be performed, has resulted in alterations in design from which users in general have benefited considerably. The automobile trade has given a great impetus to the design of grinding machines which at first were only used for finishing small circular work, and to-day we find large flat surfaces dealt with by machines which were designed specially for automobile use and which also are now available for general purposes. Moreover the practice of grinding from the rough forging as is commonly the case with crank shafts originated in connection with automobile work.

The motor trade, too, has been a very great stimulus to the design of small tool outfits, and to the development and use of precision gauges for interchangeable work; this in turn has reacted upon the development of machine tools, so that the effect of the trade on industries generally has been all for the good, as it has from the first set an example to all other manufacturers in methods and apparatus for the production of interchangeable repetition work. An instance of this may be given from the author's own experience. In one factory with which he was formerly connected it had been the practice to bed crank shafts by the time-honoured method of hand scraping. By the introduction of proper manufacturing methods he was able to eliminate this entirely, interchangeable bearings being manufactured in quantities which could be placed in their seatings, and in which crank shafts could be run, without any hand fitting, and this is now common practice.

One of the radical changes made by machine tool makers has been the extensive use of ball bearings, and again it must be noticed that the earliest ball bearings used on a car in this country were fitted on a Lanchester vehicle. As a result of this our entire perspective of high-speed bearings has been changed. Ball bearings of an elementary type were used in cycle work forty-five years ago, but it was not until they had been fitted, and their reliability proved, in cars where they were required to sustain very heavy stresses, that their use became general in machine tool design. It may also be pointed out that the use of splined shafts and hardened gears has been extended beyond the motor car industry and very largely adopted by machine tool makers everywhere. Not only has the design of machine tools been thus modified, but the entirely new industries of gear cutting and gear grinding—of both of which there are examples in this city—owe their existence to the motor car manufacturer, who frequently finds it convenient to have this difficult work done by specialists.

It is certain that the noiseless operation which is demanded in a motor vehicle has brought about a complete change, not only in the method of manufacture, but in the actual design of that ancient mechanical device, the toothed gear wheel, whilst Dr. Lanchester rescued the mediæval worm gear from the obscurity to which its unfairly alleged disabilities had relegated it, and placed it in the forefront of mechanical movements of the highest efficiency and silence. This again is an example of the automobile engineer providing a new and most useful device for subsequent adoption by the tool maker, a device also calling for new types of machines for the rapid production of worms and worm wheels, which are now an important product of this district.

From its earliest days the manufacture of automobiles has perforce proceeded along the lines of multiple production, and to secure this with economy of labour and interchangeability of products the utmost ingenuity has been exercised. Not from choice, but from absolute necessity, has the production manager been driven to the extremity of elaboration in the design of ancillary devices for holding the object worked upon and for guiding the cutting tools, all of which are now included in the singular but comprehensive word "jigs." Further, the design and manufacture of such devices has become an industry in itself, resulting in the establishment of special factories which devote their entire resources to the work, and more remarkable still, employ for the difficult processes involved special types of precision machine tools built for this purpose only; so we find the new industry of jig making, and the machine tools employed in the business well represented, as might be expected, in close proximity to the automobile factories of the Midlands.

III.

Perhaps the most far-reaching effect of the motor industry has been brought about in the department of metallurgy. Till the end of the nineteenth century steam or gas engines were the usual prime movers, and it was a maxim that such an engine should be heavily constructed; in fact, the more metal that was put into it the greater was its prospect of longevity. There was no object in designing a stationary engine of light weight for its power, hence the specific stresses in the elements of such engines were very moderate. In these circumstances there was no need to employ anything but ordinary mild steel in the manufacture of forgings, and we find that nickel and other alloy steels, although manufactured, were in very small demand. Heat treatment was consequently unnecessary and generally unthought of.

With the advent of the motor car, however, the designer was faced with the necessity of reducing weight in hitherto unthought of directions, and thus had to seek from the steel maker material which would possess the necessary strength to permit of the cross sections being greatly reduced. Arising from this need an unprecedented demand sprang up for alloy steels which could be obtained as a standard product at reasonable prices, and in contrast with the low-carbon steels with which the older mechanical engineers had worked for so many years, we now find nickel, chromium, vanadium, cobalt, silicon, manganese, and molybdenum alloys in daily use. Generally speaking, the use of alloy steels, until the commencement of the present century and apart from armament purposes, was confined to the manufacture of cutting tools, and hardening these in a blacksmith's fire constituted the only heat treatment then practised. The result of the change has necessitated the incorporation of the complicated processes of heat treatment in every-day shop practice, without which the advantage of the finer steels would be missed.

It may be said without fear of contradiction that the metallurgist owes his importance to-day in a very great measure to the motor industry, for while it is true that other industries might have made similar demands on the knowledge of the steel makers, no other has done so to anything like the same extent in so short a period of time. Automobile engineering has therefore afforded unique opportunities to both the steel maker and the metallurgist and has forced upon mechanical engineers in general, and the works manager in particular, an entirely new regimen in his shop methods; moreover, as in the case of machine tools, we find the manufacture of furnaces a not inconsiderable industry, to which the number of such appliances bearing names from this district affords testimony.

IV.

There are two Midland industries of great magnitude which have been almost wholly developed to meet the requirements of the motor car, but which are not in themselves strictly speaking branches of mechanical engineering. The first is the manufacture of aluminium. The demand for this metal in this connection is, of course, due to its lightness in weight; the automobile engineer is constantly seeking for something lighter and stronger than he has used before, and while alloy steels have been developed on account of their strength and powers of resistance, aluminium has been in demand because, while it does not

* The Institution of Mechanical Engineers, Birmingham meeting, June 29th, 1927.

exhibit in its original condition any very great strength, it nevertheless forms, within certain limits, a reliable material which can be substituted for cast iron, of which it is not more than one-third the weight.

The existence of aluminium was first suspected in 1758, but the pure metal was not isolated until nearly one hundred years later when the German chemist Wöhler produced a small quantity of metallic aluminium in 1845. For about fifty years after this the manufacture was slowly developed; by 1888 the world's annual output of aluminium was about 50 tons, which represented the total requirements for the metal until the advent of the motor car. In 1891 the price of the metal was 4s. per pound, while to-day it is approximately 1s. per pound.

In the last thirty-five years, which comprise the existence of the motor vehicle, the world's production has grown to an annual output of 150,000 tons, and this figure is constantly being increased. Approximately two-thirds of this is consumed to-day in the motor car industry, while of the remaining one-third about one-half is used for electrical purposes and the remainder for domestic utensils. The large demand for aluminium castings for motor vehicles in the Midlands has brought into existence important concerns specialising in casting this metal, and there is a large number of foundries so engaged in the Birmingham area alone.

Formerly aluminium was used in the nearly pure state, but alloyed with other metals it is now used in automobile engineering for such components as crank cases and gearboxes, and it is perhaps not generally known that it is extensively used for the wheels of heavy motor vehicles. The London General Omnibus Company now uses exclusively aluminium rear wheels. These were formerly made of cast steel, so that a very considerable saving is effected in the weight of the vehicle, and in point of strength and durability the wheels appear to be in every way equal to those made of cast steel.

In recent years, in response to the ever-growing demand for lightness and increased engine speeds, alloys of aluminium have been developed which are capable of being forged; and in the form of duralumin and similar alloys, which can be stamped into intricate sections and which possess high specific strength, the metal is in constant demand for connecting-rods and similar parts; moreover these alloys are amenable to heat treatment and their powers of resistance are increased by this means.

It is interesting, too, to note that as long ago as 1886 there was a company in existence at Oldbury for the reduction of aluminium, so that almost from the first the Midland district could include the manufacture of aluminium as one of its industries.

The other great Midland industry to which reference has been made is the manufacture of rubber, and here again the magnitude of the business (which has one of its greatest representatives within the limits of Greater Birmingham) is entirely traceable to the demands of the motor trade, and its growth in a relatively short period is an industrial phenomenon. In 1908 the world's production of raw rubber was 65,400 tons and in 1925 it had risen to 515,947 tons. This is directly due to the rapid increase in the number of motor vehicles in the country. Between the years 1904 and 1925 the total number of petrol-driven vehicles in Great'Britain had been multiplied by about 35, that is to say, the number had increased from 40,361 in 1904 to the astonishing figure of 1,373,567 in 1925. It is not surprising therefore that a firm whose name is a household word in the manufacture of tires and whose works are situated in Birmingham should be one of the largest of its kind in the whole world, employing no less than 14,000 hands.

Although the manufacture of rubber is not in itself a branch of mechanical engineering, it is nevertheless true that a large amount of machinery (and that of a very heavy type) is required for the various processes through which the material has to pass, and as this machinery is in continual use, its manufacture and upkeep is a source of constant demand upon mechanical engineering trades.

One other industry may be mentioned which, although far older than the motor trade, has nevertheless been very greatly influenced by it and particularly so in the Midlands; this is the manufacture of drop forgings in steel and non-ferrous metals—particularly duralumin—which are used more largely as component parts of motor vehicles than for any other purpose. It has already been remarked that to be manufactured successfully motor cars must be produced in large quantities; this fact is particularly favourable to the use of drop forgings as a large output is essential to offset the high cost of the dies in which the forgings are produced. The largest drop stamping works in the country are to be found in the Midland district and by far the largest part of their business is the making of forgings for the motor trade.

Now that electricity is extensively used as a source of power in machine shops of all kinds, it is natural that, with so many factories engaged in making motor vehicles the consumption of current for power purposes in the Midlands should be continually increasing. Unfortunately it is not possible to obtain a record of the total consumption of power by any individual industry; this would, of course, form a most valuable index to manufacturing activity. At the present time the general engineering trade is more than 60 per cent. electrified and the motor industry still more completely so. In the South-West Midland area 90 per cent. of the total electrical energy generated is consumed by industrial undertakings and, taking the monthly average for 1923–24 as 100 per cent., we find that in the South-West Midlands the production of electricity in 1924 was 111·4 per cent., in 1925 130·5 per cent., and in the first half of 1926 138 per cent. These figures may be considered a fair indication of the activity in motor manufacture in the district.

V.

So far we have made an examination, necessarily superficial, of some of the changes which have been brought about in the practice of engineering manufacture, changes largely due to the peculiar requirements of the motor industry, and consequent upon the change from individual to collective manufacture which that industry brought about for the first time in this country. True, the cycle and some other trades had produced their products along the same lines; but perhaps the author may be pardoned the remark that cycle manufacture, although embracing many ingenious phases, is hardly to be accounted a branch of mechanical engineering, and not until the arrival of the automobile was there a movement in engineering practice of sufficient weight to change long-established methods which had existed for half a century. But great as has been the effect produced upon the inanimate factors of engineering manufacture, still more far-reaching is the result brought about in the *personnel* attached to it.

The engineer who has to work daily on the design and production of an article which embodies half the known elements and practically every possible mechanical and electrical device, and which has to function under circumstances of the most exacting character, is it will be admitted, faced with a peculiar problem.

The pyramid of functions and processes of which in any industry some one individual has always to be the apex, is in the case which we are surveying a structure of extreme complexity. Like any other architectural entity, the stability of the whole depends upon the lowest course of masonry, which consists of the actual workers who produce the various components of the product. Nor is this all; there may be as many as 3000 separate components in a motor vehicle, and it may be taken that the average number of operations on each part is twelve. When between 30,000 and 40,000 precision machine operations have to be carried out on each of many thousand motor vehicles in a year the task becomes a formidable one.

It is perfectly true that if time were no object a single good all-round mechanic could produce (and it has been done more than once) a complete motor vehicle, but the cost of so doing would be unthinkable if any real output were required, and certainly many months would be needed for the work. Now the actual parts of a motor vehicle of average size (apart from its body-work) are made complete in about 250 hours, a result which is only accomplished by the combined skill—if the word may be permitted—of machine tools and machine operators, and the most perfect and productive machine tool is only of use when it is operated with intimate knowledge and skill. Even fully automatic machines, which may produce thousands of pieces per hour, demand the highest grade of labour to set up the tools before the actual work can be started, while tools which are semi-automatic must be guided continuously with judgment and knowledge on the part of their operators, or the work is a failure.

Machine tools have been so specialised that the same process has had to be applied to the operators, and to label such workers "unskilled" because their work is specialised is surely a misnomer. The skilled turner, faced with the problem of machining a motor piston in fifteen minutes, with some thirty dimensions (and also its weight) correct to thousandths of an inch, might well recoil from the impossible task; yet it is within the author's own experience that by dissection of the various operations this seemingly impossible undertaking is daily performed by youths with no more than a few weeks' experience, and the precision of movement which they attain in a short time fills one with astonishment.

Obviously one cannot class such labour as "unskilled"; it is most conspicuously the reverse, but it differs from the older kind in that the skilled turner, working with an unskilful machine, has to think out all the means to the end he has to attain, whilst in the case of the youth with the skilled machine this is done for him, and thus, relieved of responsibility, he is able to concentrate on the attainment of extreme skill in one operation only. Scores of other examples could be given, but the case cited is an illustration of what is happening in the modern machine shop; that is, in the shop which is devoted to the production of a standardised product in quantity.

It may be objected that the making of motor vehicles is a special trade, and is not a fair example of general mechanical engineering; the answer is that at present it may not be, but for the future there can be no question of its not being so. In the United States the making of motor vehicles is now one of the most important industries in the country, and its influence there on the methods of the other mechanical industries is an accepted fact. Competition alone will in our own case compel a similar adoption of these methods which have proved as essential in the motor trade here as elsewhere.

The fact to be faced is the undeniable shrinkage of what used to be called skilled labour. Such labour is generally considered essential in work which is only concerned with individual production, and certainly so in the department of jig and tool making. Whether this opinion is a sound one is debatable; the author for his part finds it difficult to subscribe to it; radical changes have often been necessary in the past and will probably be required again.

It would seem that there are two courses open, either to produce an exotic class of manually skilful mechanics by somewhat forcible methods, or else to recast the processes by which we manufacture individual objects, and by subdividing and dissecting them make it possible for what is at present classed as semi-skilled labour to perform the necessary work, always with the assistance of special precision machines. But such machine tools as are exemplified by what is known as the jig boring machine, must be available in much greater numbers than is at present the case, despite the great progress that has been made since the time, which the author remembers, when there were only two such machines in this country. But this is perhaps to peer too far into the future, our immediate concern being present-day conditions as they have already been affected.

It is plain that with the change from hand to machine manipulation many complex devices must be added to the machine to take the place of the operator's hand and to enable tools to be applied to the work with a force, and at the same time a precision, of which no human hand would be capable. It used generally to be stated that with the introduction of machinery the human labour so displaced would be transferred to and absorbed by those industries engaged in making machine tools; this statement cannot be supported by facts; were it true there would be no advantage, as the total ratio of labour to product, though indirectly applied, would remain the same.

The growth in output in the motor industry has been accompanied by a corresponding growth in employment, and the table given below shows the number of persons employed, in grades up to and including managers of departments, during the period of eighteen years.

There are in Britain about 15,000 men employed in the manufacture of machine tools for all purposes; in the whole world it is estimated that there are but 150,000, whilst in the automobile industry in this country the proportion of tool makers to those in all other trades is only 7 per cent. They are those who are required to produce and maintain the jigs and tools needed by the remaining 93 per cent. of the workers. Plainly, therefore, the total quantity of what was formerly classed as skilled labour has greatly diminished. What has happened is that by intelligent application of mechanical principles the quantum of human skill going into the product is no longer the same.

Number of Workers Employed.

Year.	Number employed.
1907	54,000
1911	99,000
1921	221,000
1923	220,000
1924	235,000
1925	250,000

When we speak of labour-saving devices it should be understood to imply not that less labour is employed, but that means have been placed in the hands of labour which have rendered it vastly more productive. At a time within the author's recollection the cost of an engineering product was one-third materials, one-third labour and one-third establishment charges. Four years ago the figures for the whole engineering industry as determined by the Employers' Federation were:—Materials, 43·17 per cent.; labour, 19·84 per cent.; oncost, 36·99 per cent.; while in the automobile factories to-day typical figures would be:—Materials, 75 per cent.; labour, 11 per cent.; oncost, 14 per cent.; though it would vary from 55 to 80 per cent. in the case of materials, from 15 to 10 per cent. in the case of labour, and from 30 to 10 per cent. in the case of oncost, a proportion to which the whole mechanical engineering industry must tend as methods which have proved right in automobile work are more generally adopted.

VI.

It remains but to examine the effects that this change of method has produced in the manner and amount of remuneration to the worker. At the beginning of the industrial movement about eighty years ago it was appreciated that the repetition of similar mechanical operations was immediately followed by a material reduction in the time required for their performance, and as an inducement to greater effort in this direction payment for the amount of work done was substituted for payment by the hour. It is painful to reflect to-day upon the way the resultant acquisition of skill was rewarded at that time, in complete disregard of elementary psychology, by people who should have known better. It has taken a generation to live down the result of the blunder. Happily, however, under more enlightened management an equitable system has been developed and has come into general use to the great advantage of all concerned. Whether straightforward piecework or the premium bonus system is adopted is immaterial, as either can be adjusted to give the same result; the basic principle is that for any cycle of operations an allowed time is established *and adhered to*.

It will be of interest to analyse the effect of this. For purposes of illustration we will assume a worker earning an hourly rate of 1s. who is allowed a minimum of ten hours for a certain task. We will also assume that in the factory it is found that the establishment charges or oncosts are at the rate of 100 per cent. of the productive labour. It follows that if the task is completed in the allowed time the man will earn 10s. and the cost of the work will be 20s. exclusive of the cost of material.

Table I. shows the effect, when the piecework system is adopted, of reducing the actual time for the work; for equal decrements of time the workers' rate shows a logarithmic increase while the total cost decreases at a linear percentage rate.

TABLE I.—*Piecework.*

Time taken. 1	Total earnings. 2	Virtual hourly rate. 3	Oncost. 4	Total cost. 5	Percent'e reducti'n of cost. 6
10·0	10·0	1·00	10·0	20·0	0
9·0	10·0	1·11	9·0	19·0	5
8·0	10·0	1·25	8·0	18·0	10
7·0	10·0	1·43	7·0	17·0	15
6·0	10·0	1·676	6·0	16·0	20
5·0	10·0	2·00	5·0	15·0	25
4·0	10·0	2·50	4·0	14·0	30
3·0	10·0	3·33	3·0	13·0	35
2·0	10·0	5·00	2·0	12·0	40
1·0	10·0	10·00	1·0	11·0	45
0	10·0	∞	0		

In Table II. is shown the result of working a full premium system, *i.e.*, when the whole of the time saved is credited to the worker. It will be seen that the resulting rates of payment to the worker in column 6 of this table are exactly the same as the rates in column 3 of Table I. and the percentage of cost reduction is also similar. The two systems are in effect alike with the difference that piecework disregards the workers' shop rate and the premium system takes it into account; in other words, under piecework there would be no saving through employing a low-rated man or boy, while with the premium system there would be an advantage.

TABLE II.—*Full Premium.*

When the whole time saved is credited to the worker.

Time. 1	H'rly wages earn'd 2	Time saved. 3	Bonus 4	Total earnings. 5	Virt'l hr'ly rate. 6	On-cost. 7	Total cost. 8	Perc'ge red'ct'n of cost. 9
10·0	10·0	0	0	10·0	1·00	10·0	20·0	0
9·0	9·0	1·0	1·0	10·0	1·11	9·0	19·0	5
8·0	8·0	2·0	2·0	10·0	1·25	8·0	18·0	10
7·0	7·0	3·0	3·0	10·0	1·43	7·0	17·0	15
6·0	6·0	4·0	4·0	10·0	1·666	6·0	16·0	20
5·0	5·0	5·0	5·0	10·0	2·00	5·0	15·0	25
4·0	4·0	6·0	6·0	10·0	2·50	4·0	14·0	30
3·0	3·0	7·0	7·0	10·0	3·33	3·0	13·0	35
2·0	2·0	8·0	8·0	10·0	5·00	2·0	12·0	40
1·0	1·0	9·0	9·0	10·0	10·00	1·0	11·0	45
0	0	10·0	10·0	10·0	∞	0	10·0	

Table III. shows the effect of a 50 per cent. premium

system where one-half of the time saved is credited to the worker. It is seen that the workers' rate only increases about half as fast as in the case of the full premium system and the cost decreases 50 per cent. faster.

It is for others to decide which would in the end produce the most advantageous result—the greater incentive to the worker or the greater reduction in cost. Whatever system is adopted, however, the effect is much the same, and a machinist carrying out repetition work will inevitably earn a greater sum than a more highly rated "skilled" man who has no opportunity of increasing his actual hourly rate by any amount of application.

In the automobile industry payment by results is practically universal, and as all the work is of a repetition character the result is that high wages are the rule and certainly operatives who are rated at something considerably lower than "skilled" tool makers ultimately receive very much more money.

TABLE III.—50 *Per Cent. Premium Work.*

When half the time saved is paid to the worker.

Time. 1	H'rly wages earn'd. 2	Time saved. 3	Bonus 4	Total earnings. 5	Virt'l h'rly rate. 6	On-cost. 7	Total cost. 8	Perc'ge red't'n of cost. 9
10·0	10·0	0	0	10·0	1·00	10·0	20·0	0
9·0	9·0	1·0	0·5	9·5	1·056	9·0	18·5	7·5
8·0	8·0	2·0	1·0	9·0	1·125	8·0	17·0	15·0
7·0	7·0	3·0	1·5	8·5	1·215	7·0	15·5	22·5
6·0	6·0	4·0	2·0	8·0	1·333	6·0	14·0	30·0
5·0	5·0	5·0	2·5	7·5	1·50	5·0	12·5	37·5
4·0	4·0	6·0	3·0	7·0	1·75	4·0	11·0	45·0
3·0	3·0	7·0	3·5	6·5	2·17	3·0	9·5	52·5
2·0	2·0	8·0	4·0	6·0	3·00	2·0	8·0	60·0
1·0	1·0	9·0	4·5	5·5	5·55	1·0	6·5	67·5
0	0	10·0	5·0	5·0		0	5·0	75·0

A survey of the wages paid in the British motor industry during the last four years shows that the average earnings of all classes of skilled and unskilled men have been as follows :—

Year.	Average earnings per week. s. d.
1923	71 10
1924	75 5½
1925	78 3
1926	79 5

The estimate of the Society of Motor Manufacturers and Traders of total wages paid by the industry at the present time amounts to £40,000,000 per annum.

The author has, in this brief survey, endeavoured to trace the main changes which have occurred in manufacturing procedure resulting from the development of the automobile, and has shown in what a number of directions new processes have had to be adopted to meet the exigencies of a very exacting product. It cannot be questioned that the special methods maintained on such a scale as the wages bill indicates must have a profound and lasting effect on the general practice of mechanical engineering, and more particularly in that district in which the automobile industry is mainly centred.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THE improved tone of the Midland iron and steel market remains, and while it must be admitted trade is still very slack there is an increasing tendency amongst buyers to come to business. Producers have taken up a firm attitude regarding prices, and it is considered doubtful whether they can be induced to make further price concessions. Consumers are circulating inquiries regarding possible new contracts, and a little forward business is reported to have been transacted. Many consumers, however, continue to confine their orders to small tonnages for immediate needs, hoping that prices will fall further. Once it is generally admitted that prices are at rock bottom, a fairly large volume of steady business is considered to be almost assured.

Finished Iron.

Makers of finished iron in the Midlands are experiencing a very lean time. Consumers' requirements appear to be small indeed, and now that orders accumulated during the coal stoppage have been executed, mills are unable to make anything like full production. The fall in prices, amounting as it did to 20s. per ton in the case of marked bars, has failed to stimulate demand. Most ironmasters on 'Change in Birmingham to-day—Thursday—report that business had not improved even to the slightest degree since the reduction in prices was announced. Moreover, they fail to discern any indication of returning animation in the market for finished iron. It must be admitted that in a few special departments there is still a fair call for material, but outside these particular engineering requirements trade in wrought iron has practically ceased to flow. At many of the works in this area orders are urgently needed and hopes are expressed that the contracts known to be pending from the railway companies will be placed soon. Unmarked bars and common bars, such as are required by the nut and bolt industries, are difficult to dispose of. It would appear that many users of nut and bolt qualities are heavily stocked with foreign iron. Those, however, who require additional material are indisposed to pay £10 5s. for supplies when they can get Belgian material which answers the same purpose at as low as £5 17s. 6d. delivered into the district. How the Midland ironmaster is to meet this continental competition is a problem it would seem almost impossible to solve. One thing is certain, no foreseen lessening of production costs would enable him to sell his output at anything like the present Belgian figure. Demand for wrought iron gas tube strip remains quiet. Values are unchanged.

Pig Iron.

Price deterioration in the Midland pig iron market appears to have been arrested. Smelters again this week adhered rigidly to recent quotations, and the opinion expressed in this letter last week that prices have now practically touched bottom is gaining ground. Some consumers endeavoured to induce smelters to quote special terms, but both Derbyshire and Northamptonshire furnacemen appeared to be quite firm in their resistance to any prices below £3 5s. for Northamptonshire No. 3 foundry, and £3 10s. for Derbyshire. It is on this branch of the trade that the chances of stabilisation mainly depend. Some of the foundries have been covering forward to a moderate extent, and business has also been forthcoming from merchants. Forge iron values are uncertain. The output is small, but it is quite large enough for present needs. Forges are badly off for orders. They are much worse off than the foundries, and selling prices are such an obstacle to expansion, that it is insisted the only solution is a further reduction in raw material. While furnaces are being blown out in other parts of the kingdom the few furnaces re-lit in the Midlands following the stoppage are still in operation. Their output is far in excess of market requirements, and stocks are accumulating. Blast-furnacemen now have no difficulty in getting adequate supplies of coke at the right price. There is such a surplus in the market that contracts can now be made on very favourable terms. The view that pig iron prices are at or near bottom assumes that the fall in coke has been discounted already. Smelters contend that the price has already been cut beyond the point at which profit-making is possible.

Steel.

The readjustment of prices in the steel trade which has been proceeding of late, and which has resulted in curtailment of buying has for the moment, at any rate, ceased. The price position for the past three weeks has been decidedly firm, and while as yet engineers and manufacturers are not satisfied that prices have touched bottom, they have in some instances considered it wise to buy. Inquiries regarding forward contracts have ceased to be the rarity they were a few weeks ago, and a limited number are reported to have been turned into firm contracts. New orders are, however, only coming in small quantities, and the capacity of the modern plant needs a constant flow of business to ensure full employment. Steel works are none too well placed for orders, and it looks as if business will for a time be under the influence of reaction following upon the spurt of recent months. Until consumers are convinced that more advantageous terms are not to be gained by waiting, they will not buy more than will suffice for immediate needs. That demand for steel should gradually improve, however, seems to be the general opinion. Engineers for the most part have plenty of work, and more in prospect, so that as soon as values find their level a steady call for most classes of steel should be assured. This week Midland constructional engineers have circulated inquiries for large tonnages of steel in connection with the re-building and erection of stores and offices. There is no difficulty in obtaining supplies, most mills being able to deliver in about three weeks from the placing of the order. The call for shipbuilding steel has not developed to the extent expected at the beginning of the year. A somewhat better position is reported to be slowly emerging in the shipyards, but it has not reached the stage when subsidiary industries in this part of the country participate to any appreciable extent in the revival. The price position with regard to steel is unchanged. Small steel bars are quoted at £8, soft billets at £6 15s., and angles and joists at £7 12s. 6d. Buying from the Continent is quiet, but a certain amount of semi-finished steel is being handled by Birmingham merchants. Billets can be bought at £5 7s. 6d. and sheet bars at £5 10s.

Galvanised Sheets.

Galvanised sheet prices remain easy and irregular. While some makers quote 24 gauge galvanised corrugateds £14 15s., and will not go below £14 12s. 6d., others who are more in need of business to keep the mills going accept as low as £14 10s. Business this week both on home and export account has been on the quiet side, and is circulating spasmodically.

Scrap.

The scrap market continues sluggish and offers of supplies at cut rates fail to attract purchasers. Heavy steel scrap is quoted at about £3 2s. 6d., delivered South Wales. Some Birmingham merchants, however, would no doubt be prepared to do business at below this figure.

Institution of Production Engineers.

A branch of the Institution of Production Engineers was formed in Birmingham on June 24th. Mr. R. H. Hutchinson, President of the Institution, presided at the meeting where this decision was arrived at. Mr. J. A. Hannay was appointed President of the new branch and Mr. I. Wright was elected secretary. A provisional committee was appointed to make arrangements for the operation of the branch in Birmingham. Among the general objects of the Institution, which was founded in London in 1921, are the promotion and raising of the status of engineering as applied to production and to initiate and carry through any scheme likely to be useful to members of the Institution or the community with regard to engineering production.

Proposed County Mining College.

With the aid of a grant of £18,000 from the Central Miners' Welfare Fund, it is proposed to erect a county mining institute at Cannock. Preliminary sketch plans were approved by the Staffordshire Education Committee on Saturday last week. The plans provide for the erection of a building comprising a combined physics and electrical laboratory and repair department, a metallurgical engineering room, along with a principal's staff and a secretary's room on the the ground floor. On the same floor is to be a mining laboratory. On the first floor over the front portion of the building provision is made for a drawing-office, along with surveying and geology depts., and a committee room. It is estimated that the cost of the building—with the exception of the mining laboratory—will be covered by the grant of £18,000 from the Miners' Welfare Fund, but the cost of the laboratory and the whole of the machinery and equipment will be a charge upon the county fund.

Coal Trade Improving at Cannock.

I am able to record that the coal trade in Staffordshire, East Worcestershire and Warwickshire area is now showing signs of improving. Especially is this the case in the Cannock Chase coalfield, where during the past week the number of miners signing the register at the employment exchange has been reduced by over 700. At several of the pits in this district some good orders have come to hand, and for the first time for several months these collieries have worked a full week. There are, however, over 5000 local miners still drawing the "dole." The ascertainment under the new wages agreement for the Cannock Chase coalfield will be made this week, and with trade having been so slack and pithead prices having fallen during March, April and May, the period for which the output, selling prices, &c., govern the rates of pay for July, it is generally anticipated that there will be a substantial reduction on current wages.

Coalowners' Losses.

In reference to the statements made as to losses in the coal industry, the view is expressed by competent authorities in this area that a better position may be disclosed in the Warwickshire and East Worcestershire areas compared with other parts of the country. At the moment, it is impossible to say what the results of the ascertainment based on March, April and May will disclose, but it is certainly not anticipated that the figures will disclose such a gloomy outlook as that taken by Mr. Cook.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Colonial Markets.

THE effect of changed conditions in the Indian and colonial markets on British firms was discussed by Mr. Leonard Sumner at the annual meeting in Manchester of the Broughton Copper Company, Ltd. Owing, he said, to the changed policy of the Indian Government and some of the colonial Governments, who either fostered their own manufactures or, if there were none, threw their markets open to all comers instead of, as formerly, confining them to British manufacturers, they had become the dumping ground of the protected countries of Europe and America, in which they got rid of their surplus production at or below cost price. The company had also to meet the competition of what the speaker described as second-hand material—tubes made from "any old metal." Dealing with the question of production, Mr. Sumner said that the output of manufactured goods of the Broughton Copper Company and its subsidiary company, Messrs. Bibby's, was some 25 per cent. above that made at the corresponding period of last year. They had gone in for new and more modern plant with a view to decreasing the cost of production and not so much to increase the production. Unfortunately, owing to the enormous extension of works that took place during the war, for war purposes, there was too much power of production, not only in this country, but throughout the world at large. The company's profits during the past year were down to £41,000, compared with £63,000 in the previous year, the fall being due entirely to the extra cost of fuel and the decreased turnover resulting from the coal stoppage.

Cheaper Electricity.

The Manchester Corporation Electricity Committee have decided to make alterations and reductions to certain of its rates, although no alteration has been made to the flat rates. The lighting compound running charge, which chiefly affects shopkeepers, has been reduced by one farthing per unit, and restricted time supplies for power also by one farthing per unit. The latter reduction principally affects small power users who can afford to refrain from using power during the busy hours. The Electricity Committee has also decided to institute a new rate for cooking for business purposes, where the cooking installation is not less than 10 kilowatts. The rate will be one penny per unit for a restricted supply outside the hours between 3.30 p.m. and 5 p.m. from November to February inclusive. If the supply is not restricted consumers are to pay the full year's charge of £4 per kilowatt. Street lighting charges on the City Fund account are to be reduced by one-eighth of a penny per unit.

Engineer Visitors.

A display of high-voltage electrical discharges was given in the high-tension testing laboratory of the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, on the occasion last week of the visit of about 120 members of the North-Western Centre of the Institution of Mechanical Engineers. Mr. Harold Massey, chairman of the Centre, was a member of the party, who were conducted round the works by Captain R. S. Hilton, deputy chairman of the company, Mr. G. E. Bailey, a director, and members of the company's staff.

Non-ferrous Metals.

Apart from a somewhat spectacular recovery in tin, which, however, was not maintained, the market for the non-ferrous metals during the past week has been dull. Of the statistical strength of the tin market there can be no doubt, for a further reduction is shown in the latest

returns relating to stocks in domestic warehouses. It has been this rather than any pressing demand—although a temporary spurt in the latter helped matters—that has strengthened the market. With spot supplies of the metal distinctly short the value of cash, for the first time since the middle of April, passed the £300 mark. This improvement, however, was only short-lived, and at the time of writing cash on balance is but a few shillings higher than a week ago, whilst forward positions have actually lost ground. The demand both for raw copper and for the manufactured metal has been quiet during the week, although the cable-making industry has been placing fair orders for bars. In striking contrast to tin, offers are plentiful, with a consequent depressing influence on prices. Cash is fractionally lower than a week ago, although the forward position is about maintained. In the case of spelter market opinion seems to be inclining to the view that prices have reached the fullest extent of their fall. This section has certainly been rather steadier, with values more or less where they were at last report, although so far the demand has not improved. Lead also is maintained at the level of a week ago, but here again current buying is largely of a hand-to-mouth character.

Iron.

If the market experience in the early days of this week is a fair criterion, the somewhat brighter outlook reported a week ago has been of limited duration. Whether or not this be the case, the fact remains that there are few sellers who are in a position to report any perceptible improvement compared with the experience of recent months. A week ago it was possible to meet some who had effected sales of a fair aggregate tonnage for delivery over a period of several months, but this week the great bulk of the business reported has been in connection with deliveries during the near future, an experience which has been pretty general throughout the market. There is, however, undoubtedly a much steadier feeling with regard to prices, and buyers themselves are not expecting values to come down much below their present levels. Taking the entire range, quotations are much the same as at last report, with Staffordshire brands quoted at 77s. to 78s. per ton, delivered Manchester, Derbyshire at 78s., Scottish at 96s., Middlesbrough at 83s., and East and West Coast hematite at 91s. 6d. to 92s. per ton, also delivered in each case. Lancashire bar iron keeps steady at £11 for Crown and £10 for second quality, but the demand for this remains slow and there is no indication of improvement.

Steel.

Apart from a very limited number of orders for ship and boiler plates for forward delivery, there has been little buying of consequence in the steel market here, and, pending a lower range of prices, which consumers seem to be looking for, most buyers still seem content to limit their commitments in accordance with their immediate needs. Prices at this centre have shown virtually no alteration, boiler plates being quoted at £11 5s. per ton, ship plates at £8 7s. 6d., sections at £7 12s. 6d., and bars at from £8 to £8 12s. 6d. per ton. Weakness continues in evidence in the market for imported materials, and as merchants in this area are understood to be holding fairly heavy stocks of foreign steels—both finished and semi-finished products—there is an entire absence of any sign of activity so far as fresh business is concerned. About £5 7s. 6d. per ton is being quoted here for continental sheet bars, £5 2s. 6d. for billets, from £6 12s. 6d. to £6 15s. for wire rods, £7 to £7 2s. 6d. for ordinary plates, £5 12s. 6d. to £5 15s. for joists, and £7 7s. 6d. to £7 10s. for Siemens plates, these prices including delivery to users' works in this district. Galvanised sheets are a very dull section and values are weak at from £14 7s. 6d. to £14 10s. per ton f.o.b., for the usual Indian specifications.

Scrap.

Trade in non-ferrous scrap is on limited lines and in most cases prices have an easy tendency, scrap lead being quoted at £24, zinc at £23, clean light copper at £56, heavy yellow brass at £44, cast aluminium at £75, and selected gunmetal at £52, for graded qualities, delivered to buyers' works.

BARROW-IN-FURNESS.

Hematite.

There is little difference in the hematite market. There are a few signs of better trade in pig iron, but as yet it is too early to attach too much importance to them. Overseas deliveries show a slight improvement, but in the past, as this trade has not been very steady, it may be that the present deliveries will not develop into a regular trade. In the home market there is still a considerable amount of hesitation, and unless there is a decided improvement in demand there may be restriction in output. This applies to practically every part of the district, as it is thought inadvisable to allow stocks to accumulate to any great extent. Special qualities of pig iron have been similarly affected—perhaps with the exception of ferro-manganese—which appears to be experiencing a steady demand. The iron ore mines are beginning to feel the effect of the depression in the iron market and some of them are not very busy at present. The steel trade continues to be dull, although in Cumberland orders for railway material have been secured, which should make it possible for the works to run practically continuously up to the holidays. Barrow is similarly circumstanced in regard to rail orders, having contracts which will keep the mills going for a month or more.

The Prince of Wales' Visit.

On Wednesday the Prince of Wales, continuing his tour of certain parts of Lancashire, was at Barrow. He went through the works of the Barrow Hematite Steel Company, Ltd., being received by Mr. G. Mure Ritchie, chairman of directors, and then proceeded to the Barrow Shipyard, where he was received by Commander Sir Trevor Dawson, R.N., chairman of the Armaments and Shipbuilding Board of Vickers Ltd., and by Commander C. W. Craven, R.N., managing director of the Barrow works.

SHEFFIELD.

(From our own Correspondent.)

Heavy Trades Quiet.

A STATE of general quietness prevails in the heavy iron and steel trades. For some weeks past the furnaces have been overproducing, and in the case of iron stocks, these have accumulated to such an extent that big lots are being offered at severely cut prices in order to effect a clearance and so ease the position. Unless the stocks can be cleared without much delay there is a danger that some of the furnaces will have to be stopped, but every effort possible is being made to avoid this serious course. The offering of these cheap deliveries for clearance has naturally upset the forward market. In the steel market the conditions are hardly more satisfactory. The half-yearly stocktaking will shortly be undertaken, and in some cases the quietness of business is inducing a stoppage longer than usual to be made. Other firms have found that work has tapered off so sharply that, apart altogether from stock-taking they have found it policy to close down for a week and reduce their expenses, while allowing orders to accumulate, rather than go on working with comparative oddments. The rolling mills are reflecting the general falling off in business, which it is trusted is only temporary. The particulars disclosed in Parliament last week of the prices at which continental pig iron and steel are being offered in Scotland are equally applicable to this district. Siemens-Martin high-carbon steel billets of continental make are being offered for delivery in Sheffield at prices which are from 18s. to 34s. 6d. per ton less than the Sheffield prices on the spot. From the point of view of the steel maker, they are disturbing figures, for there is no doubt that the foreign prices are attracting an increasing amount of local business.

Wire Rod Trade.

This point was strongly emphasised by Mr. H. C. Else, the chairman of William Cooke and Co., Ltd., of Tinsley, Sheffield, at the annual meeting of the company, in referring to the wire rod trade. This, says Mr. Else, is suffering mainly because of the enormous amount of wire rods that are coming from the Continent. So serious has the position become that there are more wire rods coming into this country than are being produced by the whole of the rolling mills here. As already announced, William Cooke and Co., intend to establish works at Vancouver for the manufacture of wire ropes. This decision, it is understood, has been arrived at owing to the tendency in British Columbia to buy only material manufactured in the Dominion of Canada. So far as can be seen, the putting down of a ropery at Vancouver is not going to cost the company very much more in the matter of capital than it does at present, because it is now obliged to keep large stocks in British Columbia.

The Tool Trades.

These are variable, for whereas some firms are working a full week others are having a lean time. On the whole, business cannot be said to be improving, and prices are still as finely cut as ever. Trade in files has fallen away again, and some of the factories are extremely short of work. An Admiralty contract for 20,000 dozen files and rasps has been shared among eight firms, and it is said that very low prices were quoted for them. It is now practically certain that there will be no Russian business this year in either files or saws, though local makers are hopeful that this trade will come again next year when the present trouble has blown over, or, at any rate, is less keenly emphasised.

Plate and Cutlery.

There are no particular points of interest to note this week in the plate and cutlery trades. The colonial market is remaining steady, but the great weakness is in the home market. It is true that useful contracts continue to be placed at intervals by shipping companies and other concerns with important catering interests, but trade through the medium of shops declines to improve. Ever since the beginning of the year the public has been buying very sparingly, and it is also reported that the Christmas trade was so much below anticipation that stocks bought then are still uncleared. This particularly applies to plated articles. Fairly good business is being done in the cheaper cutlery, spoon and fork trade.

Two "Pacific" Engines.

The finishing touches are now being applied at the Doncaster railway plant works to two "Pacific" engines, which it is expected will be used on the proposed London and North-Eastern non-stop run from King's Cross to Newcastle. The engines are being fitted with new boilers which will have a working pressure of 225 lb. per square inch, compared with the existing boiler pressure in "Pacific" engines of 180 lb. per square inch. The valve gear is also being altered, with a view to effecting a considerable saving in coal and water, and experiments, it is understood, have proved highly successful. There is already at least one "Pacific" engine in service with the altered valve gear, which has made a great difference in the amount of fuel consumed.

Coal Developments.

The Askern Coal and Iron Company, Ltd., of Askern, near Doncaster, has applied to the Railway and Canal Commission for authority to work 592 acres of land for coal, comprising the Barnsley and Flockton seams, and situated in the parishes of Askern, Norton, Campsall, Sutton, Fenwick, Haywood, and Moss. The application was made under the authority granted by the Mines (Working Facilities and Support) Acts of 1923 and 1925. It is estimated that there are 2,800,000 tons of workable coal in the Barnsley seam, and 2,400,000 tons in the Flockton seam. The coal lies under small parcels of land, and for this reason the applicants maintained that the coal could not be worked properly by anyone else. The hearing of the application has been adjourned. J. and G. Wells, Ltd., Eckington Collieries, near Sheffield, has agreed to increase its borrowing powers from £150,000 to £250,000. The company has now an equilateral triangle with a pit at each of the corners, and two of the pits, Norwood and Westhorpe, are new. According to the managing director, the collieries are capable of considerable development, and he believes they can produce 800,000 tons per annum for 100 years. A large amount of the equipment necessary for raising the output to that level is already installed, and it is not thought that it will be necessary to spend more than £20,000 for that purpose.

Derby Firm's Big Contract.

The contract for the construction of the Gorple reservoirs for Halifax Corporation has been placed with R. Lehane, Mackenzie and Shand, Ltd., civil engineering contractors, of Derby. The contract price is £731,225. The completion of the work will occupy about six years, and includes the construction of two dams, the higher being 1100ft. long and 87ft. high, and the lower dam 1500ft. long and 100ft. high. The site of the reservoirs is on the eastern slopes of the Pennine Range, between Hebden Bridge and Burnley. The firm is also carrying out reservoir works for the Batley Corporation and is building an aqueduct for the Cardiff Corporation.

Electricity Award.

As a result of the proceedings to determine the price Sheffield Corporation should pay the Yorkshire Electric Power Company in consideration of Sheffield taking over the company's electricity undertaking in Wadsley Bridge on that area's absorption by the city, a sum of £68,000 has been awarded. The amount claimed by the company was £106,156, and the valuation submitted by the Corporation was £16,960.

Cheaper Gas.

Sheffield industries, which are big users of gas, will benefit considerably by the decision of the Sheffield Gas Company to reduce the price of gas from this quarter's readings. For the very large users the price reaches the low figure of 1s. 4d. per thousand cubic feet, which is 4d. below the pre-strike price, and is easily one of the lowest, if not the lowest, in the country.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Gloomy Outlook.

INDUSTRY in the North of England has entered upon the second half of the year in an atmosphere of settled gloom. With the holiday season approaching, business is usually slack at this period of the year, but the depression has seldom been so acute. The coal trade continues in a parlous state. Another large colliery has been closed down this week and 1800 men and boys thrown out of employment, while other pits are having to resort to the one-shift system. Even then operations are restricted to three and four days a week in some cases. The pig iron trade shows little signs of animation, and ironmasters are threatening to put more furnaces out of blast unless there is an improvement in the demand in the very near future.

Cleveland Iron Trade.

The total volume of business passing in the Cleveland iron trade is on a very disappointing scale, and a vast improvement in demand is necessary if the present producing plant is to be kept in operation. Several firms have entered upon the second half of the year with a considerable amount of work on hand, but the fact that orders coming forward are nothing like sufficient to ensure continuity of operations when these are completed is causing much anxiety. Foreign business is scarce, sales to Scotland very restricted, and even the local market is still not secure from foreign competition. Imports of foreign iron continue on a fairly heavy scale, and it is reported that a further 2000 tons has just been bought for a Middlesbrough foundry. Such news is doubly disturbing, as it was thought that at least the Cleveland market was secure against foreign competition. Prices on the Continent, however, seem to have fallen away again after a temporary stiffening, and sales of No. 3 foundry are reported at 60s. per ton f.o.b. Antwerp, as compared with 70s. per ton f.o.b. Middlesbrough for No. 3 Cleveland pig iron. Cleveland makers insist that there can be no further price cuts so far as they are concerned, and that if business does not improve, blast-furnaces will have to be stopped. Quotations are unchanged from last week, No. 1 Cleveland foundry iron being 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. per ton.

Hematite Pig Iron.

East Coast hematite pig iron is selling just a little better, and with output small stocks are stated to be decreasing a little. This should strengthen the market somewhat, but makers are still pressing sales, and are prepared to accept below recognised market rates rather than miss orders. Mixed numbers are 77s. to 77s. 6d., and No. 1 is at a premium of 6d.

Ironmaking Materials.

In the continued absence of business in the foreign ore trade, reliable quotations for that commodity cannot be given. Blast-furnace coke prices are easy, and consumers are disinclined to negotiate for supplies, believing that quotations have not yet touched bottom. Good average kinds are put at 20s. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade presents no new feature. Manufacturers are well sold over the next few months, but orders are not being placed any-

thing like so quickly as they are being cleared off. Works, however, have not yet been compelled to restrict output. Prices are firmly maintained.

Ironstone Mine to Close.

The whole of the men engaged at the South Skelton ironstone mine have received notice to terminate their employment at the end of next week, owing to the falling off in the production of Cleveland pig iron.

The Coal Trade.

Much satisfaction is expressed in Northern coal trade circles that the restrictions on the import of coal into France may be removed in a few months. It is probably being found that the disadvantages attaching to the decree in the way of less work for French vessels to carry coal, unemployment at the discharging places, and consumers having to pay a higher price for inferior fuel, far outweigh the advantages, and that the opposition in France to the limitation has become irresistible. Up to the present there does not seem to have been any difficulty in securing licences, and a large amount of Durham coal has been shipped to France. The second half of the year has opened with the general condition of the coal market fairly steady, but without any sign of an improvement in the volume of trade. It is really a weak position, but with some redeeming features. Best qualities of steam fuel, for example, are favourably placed for the next few weeks, save for a few cases where tonnage has fallen out of position. In other respects, this section is doing tolerably well, there having been some fairly substantial sales lately of second steams. Sellers are not numerous nor pressing on the market, and prices are steadily maintained at 14s. 6d. for best Northumberland steams, and 13s. 6d. for secondary sorts. Smalls are causing no anxiety at the moment, the output being steadily disposed of at current prices. The Durham gas coal position is irregular. There is a plentiful supply, but holders adhere to recent prices, best qualities being 16s. 6d. to 16s. 9d., and seconds 14s. 3d. to 14s. 9d. Blast-furnace and ordinary foundry cokes are weak, and gas sorts steady. Although trade is in so uncertain a condition, values appear to be stabilising. Despite the moderate inquiry, there is no disposition on the part of the producers to make any further concessions.

SCOTLAND.

(From our own Correspondent.)

Poor Outlook.

WITH six months of the present year gone no improvement in industrial circles has been forthcoming and present indications are not favourable. Buyers on all hands are acting with the greatest caution, and there appears to be an almost entire lack of confidence in the various markets. Home producers continue to experience keen foreign competition at home as well as abroad, and under present oncosts are evidently quite unable to provide an adequate counter to foreign quotations. Business may be improving in some directions, but a considerable period must necessarily elapse before any benefit is felt in other departments of industry. The steel, iron and coal trades all suffer keenly from a lack of demand, and nothing has happened within recent weeks calculated to engender any confidence in the immediate future of these industries. Already there has been talk of extended holidays, and such is likely to happen unless something unforeseen should occur within the next two weeks or so.

Steel.

Many steel makers have almost reached the end of their commitments against contracts held up during last year's strike, and will soon be on the outlook for fresh business. Business meantime is of a small day-to-day character, and there is little indication of any change for some time to come. Most of the works are now in a position to give early delivery, this being the case especially in plates. Prices are unchanged.

Steel Sheets.

Makers of heavy sheets are not too well placed and competition for black and galvanised varieties is very keen. Light sheets, however, are booking a fair amount of fresh business, and orders are being arranged as far ahead as October-November, particularly for galvanised descriptions.

Iron.

The pig iron market continues inactive and weak. The small output is more than adequate to meet all demands and quotations are slowly but surely descending. The bar iron works are only partially engaged, and this applies also to the re-rolled steel departments. Bar iron at £10 15s. home and £10 10s. per ton export has a poor market, while re-rolled steel bars at £8 2s. 6d. and £7 17s. 6d. per ton respectively receive little attention.

Exports and Imports.

Traffic at Glasgow harbour so far as iron ore was concerned showed a further decrease last week. Only three vessels discharged cargoes to a total amount of 7000 tons. The import of iron reached 700 tons. Iron exports amounted to 4700 tons, the largest consignments of which were despatched to Australia, South America, and Rangoon.

Coal.

Reports from all districts indicate a continued shortage in business for home and export. Round fuels are especially hard hit, and despite restricted outputs supplies are in excess of demands. The only exception is found in the case of Lanarkshire splints, which are fully booked a week or two ahead. Reduced outputs have created a shortage of all sizes of washed nuts and these are steadily rising in price in all districts. Aggregate shipments amounted to 236,562 tons, against 225,039 in the preceding week and 250,732 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THERE has been practically no change in the conditions prevailing in the steam coal industry of this district during the past week. The position leaves a good deal to be desired, as it can scarcely be said that any colliery is working full time, while quite the majority are experiencing great difficulty and are working intermittently. No development has occurred so far as the export of coals to France is concerned, and it is interesting to note that last week shipments were actually larger than for the week previous. While the quantities of individual undertakings have been cut down, there are hopes that as licences have been granted in other directions, shipments in the aggregate will be upheld. According to a report from Paris, the Minister of Public Works explained the situation to the Mines Committee of the Senate, and pointed out that in practice the decree only affected large public services which accounted for only 14·6 per cent. of the annual consumption. The decree, he went on to say, would enable French collieries whose coal stocks amounted to roughly between 2·5 and 3 million tons to dispose of them and maintain employment without any reducton of wages. He was confident that within a few months the steps taken would bring such an improvement in the position as might permit the restoration of free imports. Certainly so far as this side is concerned, alarm has subsided and the best is being made of the position as it stands. Apart from French business, however, the conditions are generally very quiet. The Portuguese State Railways have purchased 10,000 tons of large and small coals, and it is reported that a Brazilian order has been placed for 50,000 tons of Welsh coals. The current inquiry continues to be generally very slow, and few are optimistic to look for any revival of trade until the autumn. Hopes had been entertained that the strike in the American coalfield would by this time have had some effect upon the demand from this country. So far, this has not been the case, however, and a telegram received by the Cardiff Chamber of Commerce last week from a kindred association in New York states that there is no possibility of a shortage on the other side, as non-union mines have been stocking up and others stocked up well before April. Also there has been no big draw on stocks on account of the summer. As to the prospect of a settlement of the strike, the telegram adds that there are no immediate chances of this.

Miners' Wages.

The award of the independent chairman of the South Wales Coal Board, Sir Francis Taylor, on the question of the subsistence wage payable to the lower-paid workmen was received on Monday last. It will be recalled that the coalowners sought for a reduction from 8s. 0½d. per day to 6s. 9d. per day, this being stoutly resisted by the men's leaders, who considered that it should be raised from 8s. 0½d. to 8s. 6d. per day. The effect of the award is that there is no change in the amount, and the independent chairman has declined to agree to the demand of the coalowners. The secretary of the Enginemen, Boilermen and Craftsmen's Association has expressed disappointment with the award, and he says that he intends to approach the coalowners in order to have removed the anomaly, brought about by the award, of craftsmen receiving the same as non-craftsmen. At a meeting on Saturday last the Executive Committee of this organisation considered the agenda for their half-yearly general meeting, and it was reported that resolutions had been received from the branches requesting the Executive to approach the coalowners for an increase of 2s. per day on the standard rates to all members of the Association and an allowance of not less than 2s. 6d. per week to all craftsmen for tools. Protective measures against the action of acids are also to be sought for all craftsmen employed in electric lamp rooms.

Development of Trade.

On Friday last, at the invitation of the directors of the Great Western Railway Company, a party of about 400, representing the commercial and business interests of the country and particularly the London, Midlands, West of England and South Wales areas, visited Newport and Cardiff, and made a tour of the docks and inspected the facilities provided for dealing with trade. Subsequently, the party were taken to the City Hall at Cardiff, where they were entertained to lunch, at which Sir Henry Mather Jackson, Bart., presided. Sir Henry stated that the Great Western Railway Company was the largest single dock-owning company in the world, and the value of the undertaking was £20,000,000. Mr. C. S. Page, the chief docks manager, pointed out that the policy of the company was to develop the general cargo trade as much as possible. During the five years the company had had the docks in South Wales, it had spent £4,000,000 on them in renewals, maintenance and improvements, whereas the amount formerly spent on the docks in those directions averaged £200,000 per year. Twenty-two liners were making regular calls at Newport and twenty-three at Cardiff, which showed that the facilities existed for developing overseas trade.

Pitwood Cranage Charges.

The Great Western Railway Company has put forward a proposal for increasing the cranage charge for discharging pitwood at Cardiff, Penarth, Barry and Newport to 6d. per ton as and from July 1st, this being in consequence of the loss which the company incur on the cranage service. The cranage rates at Cardiff are at present 4½d. per ton, but at Barry there is an all-in charge which includes the cost of labour. The matter has been discussed by the Executive Committee of the Cardiff and Bristol Channel Pitwood Importers' Association, and it has decided to oppose strenuously the suggested increase. In a reply to the company it states that the necessity is for reduction rather than increase of the charges.

S.W. Miners' Federation.

The balance sheet of the South Wales Miners' Federation for the past year has been issued, and discloses that the aggregate revenue of the year was £365,686, which includes the grant of £301,564 from the M.F.G.B. and of £18,852 representing cheques not cashed by the end of 1926, but included in that year's expenditure. The year's expenditure included £327,967 in grants to unemployed miners, £4855 in contributions to the M.F.G.B., £7184 to political fund, £12,149 in litigation, and £10,285 in administration. All that the Federation received from its members during the year was £38,138, compared with an average of over £110,000 in the two previous years. The average amount distributed by the Federation in grants to its unemployed members during the year amounted to only about £2 3s. per member.

Tin-plate and Steel Trade.

When the annual meeting of the Joint Industrial Council of the Welsh Tin-plate Trade is held next week, the men's side propose bringing forward the question of the employers' pooling scheme, their contention being that consideration should be given to the employees by a process of distribution of work as far as possible amongst them rather than by the complete closing, when necessary, of individual works. Five sheet mills at Messrs. Gilbertson's tin-plate works at Pontardawe recommenced on Monday after several weeks' stoppage. Five hundred men are affected by a complete suspension of work for a week at least at the Elba Steel Works, Gowerton. The smelting furnaces have been closed down since Whitsuntide, and on Saturday last the bar mills were closed. Of the eight mills at Cwmbwrla Tin-plate Works, four re-started on Monday, the men having agreed to share the work.

Tin-plate Trade Conditions.

The conditions in the tin-plate industry are far from satisfactory. It is estimated that not more than 40 per cent. of the mills are operating, and the inquiry for plates is slow. The question of the amendment of the wages sliding-scale was recently discussed by a meeting of the men's side, when it was reported that the Committee which met the employers' representatives failed to persuade the latter to agree on the chief point in the men's proposals, viz., that the basis of the scale should be changed from the selling price of steel bars to the selling price of tin-plates, the suggested zero point being altered from £7 10s. per ton of steel to 15s. per box of tin-plates. The meeting of the men's side agreed to continue with their efforts to effect this change, but it will be some time before a decision, if any, can be reached.

Colliery Officials' Wages.

Meetings took place on Tuesday between representatives of the coalowners and the Examiners' Association and Master Hauliers' and Traffic Foremen's Association, when, although no formal agreement was signed, it was understood that there should be a reduction in wages of these officials as from the first week in July to the extent of placing them on the same basis as that which obtained prior to the 1924 agreement.

Current Business.

There has been no alteration in the state of the steam coal market. The conditions are very irregular as regards the prices that are quoted by the collieries, which are guided entirely by their individual position. There have been many stoppages of pits. The need is for prompt orders, whereas the inquiry from abroad is comparatively meagre. Stocks of coal are very heavy, owing to the lack of a ready outlet. At the end of last week there were forty-four idle loading appliances at South Wales docks, and this week commenced with there being just over thirty vacant berths. This is not a healthy position. Best Admiralty large coals do not command more than 21s. 6d. at the most. Smalls are fairly steady, while washed coals are about the best market on account of the shortage of supplies, due to the numerous pit stoppages brought about by the slowness of large coals moving off. Patent fuel is fairly steady, but pitwood is a shade easier.

INSTITUTION OF MECHANICAL ENGINEERS.—More than one hundred members of the North-Western Branch of this Institution paid a visit of inspection to the works of Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, on Wednesday, 22nd ult. The party included the chairman of the branch, Mr. H. F. Massey, and was received by Captain Hilton and Mr. G. E. Bailey. A very interesting afternoon was spent in the many sections of the works. In the mechanical department the visitors were able to inspect large steam turbines and condensing plants which are in course of construction. These include two steam turbines for Bristol Corporation, each 20,000 kW at 3000 r.p.m.; one set for Liverpool Corporation, 25,000 kW at 1500 r.p.m.; one set for Manchester, 41,000 kW at 1500 r.p.m.; and two sets for Krasni, Russia, of 45,000 kW each at 1500 r.p.m. Amongst condensers the following were seen:—Two for Tsurumi, Japan, each of 43,000 square feet; one for Liverpool, 37,800 square feet; two for Bristol, each 18,000 square feet; two for Oldham, each 16,600 square feet; and one for Moges, Russia, 12,820 square feet. In the gear-cutting section were two sets of gears for H.M. Australian S. Albatross, each gear being for 6000 horse-power, reducing from 3000 and 2200 r.p.m. to 240 r.p.m. The newest feature of the works is the overspeed test-house, a bomb-proof building used for making overspeed tests on rotating machines. It was described in THE ENGINEER of December 31st last. The research department presented many features of interest, the most spectacular being electrical tests at a pressure of 1,000,000 volts. At the conclusion of the visit the company was entertained at tea, when a vote of thanks was accorded to the hosts for their kindness in allowing the members to view the works.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 2 6	
No. 1 Foundry	4 5 0	—
No. 3 Foundry	4 0 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 17 0	3 17 0
No. 1	3 17 6	3 17 6
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 1 6	—
(3) Northampton—		
Foundry No. 3	3 5 0	—
Forge	3 2 6	—
(3) Derbyshire—		
No. 3 Foundry	3 10 0	—
Forge	3 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	3 12 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 11 6 (a); 4 14 6 (b); 4 18 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 15 0 to 11 0 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	12 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 3/16 in. to ½in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

N.E. COAST—	Home. £ s. d.	Export. £ s. d.
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
MANCHESTER—		
Bars (Round)	8 15 0	—
,, (Small Round)	8 0 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 5 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 0 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	8 0 0 to 8 10 0	
Billets and Sheet Bars	6 15 0 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 10 0 to 14 12 6	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/9 to 19/-
Block Tin (cash)	296 5 0
,, (three months)	284 15 0
Copper (cash)	53 13 9
,, (three months)	54 7 6
Spanish Lead (cash)	23 18 9
,, (three months)	24 6 3
Spelter (cash)	28 3 9
,, (three months)	28 7 6
MANCHESTER—	
Copper, Best Selected Ingots	58 17 6
,, Electrolytic	60 2 6
,, Strong Sheets	84 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	25 10 0
,, Foreign	24 5 0
Spelter	28 10 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/9½ per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	13/-
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

LANARKSHIRE—	Export.
(f.o.b. Glasgow)—Steam	13/6
,, ,, Ell	14/-
,, ,, Splint	15/3 to 17/-
,, ,, Trebles	16/- to 16/6
,, ,, Doubles	15/- to 16/-
,, ,, Singles	13/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/9
,, ,, Jewel	15/6
,, ,, Trebles	16/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 13/6
Screened Navigation	18/- to 19/-
Trebles	16/6 to 17/-
Doubles	14/6 to 15/-
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9 to 13/-
Secondary Steam	12/3 to 12/6
Trebles	16/6
Doubles	14/6 to 15/-
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	26/6
Household	42/6 to 58/6
Coke	25/6 to 26/6
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	13/- to 13/6
Steam Smalls	10/6
Unscreened	13/- to 13/6
Household	21/- to 27/-
DURHAM—	
Best Gas	16/- to 16/6
Second	14/- to 14/6
Household	21/- to 27/-
Foundry Coke	19/- to 26/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 28/6 —
Best Selected House Coal	21/- to 22/6 —
Screened House Coal	19/- to 21/- —
,, ,, Nuts	16/- to 17/6 —
Yorkshire Hards	16/- to 17/- —
Derbyshire Hards	16/- to 17/- —
Rough Slacks	10/6 to 11/6 —
Nutty Slacks	8/- to 9/- —
Smalls	3/- to 5/6 —
Blast-furnace Coke (Inland)	22/- * —
,, ,, (Export)	f.o.b. 17/6 to 18/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/6 to 21/6
Second ,, ,,	19/6 to 20/6
Best Dry Large	19/6 to 20/-
Ordinary Dry Large	18/6 to 19/-
Best Black Vein Large	19/6 to 20/-
Western Valley Large	18/6 to 19/-
Best Eastern Valley Large	18/- to 18/6
Ordinary ,, ,,	17/- to 18/-
Best Steam Smalls	13/9 to 14/-
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 21/6
No. 3 Rhondda Large	21/- to 22/-
,, ,, Smalls	16/- to 17/-
No. 2 ,, Large	17/- to 18/-
,, ,, Through	16/- to 16/6
,, ,, Smalls	13/- to 13/6
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	30/- to 32/6
Patent Fuel	24/- to 24/6
Pitwood (ex ship)	28/6 to 29/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	38/- to 42/-
Seconds	30/- to 35/-
Red Vein	25/- to 30/-
Machine-made Cobbles	45/- to 47/6
Nuts	40/- to 45/-
Beans	30/- to 35/-
Peas	19/- to 21/-
Breaker Duff	8/- to 8/9
Rubbly Culm	9/9 to 10/-
Steam Coals:	
Large	20/6 to 21/6
Seconds	18/6 to 20/-
Smalls	11/- to 12/-
Cargo Through	16/- to 17/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Outlook.

THE future of the iron and steel trades is unfavourably influenced by certain economical incidents which are seriously compromising any hope of an early recovery. The rumour that Germany has broken off negotiations for a commercial treaty is declared to be unfounded, but it is nevertheless understood that Germany declines to renew the temporary agreement beyond the end of June unless France admits German goods under the minimum tariff until the end of the year. The French Government has rejected those conditions. Meanwhile it has postponed still further the debate upon the proposed new import duties, as the character of the Tariff Bill has raised so many unforeseen difficulties that it is hoped to overcome them as far as possible before presenting the measure to Parliament again. All this deprives trade of any confidence in the early future. There is no buying except to satisfy immediate needs, and steel prices are regarded as lower than they should be in view of the higher production costs. Some uneasiness is caused by the failure of makers to sell girders in competition with reinforced concrete. Contrary to what had been expected when steel girder prices came down, there is no evidence of steel making headway against concrete, but rolled steel exports are, on the whole, satisfactory, and the exports of rails during the first five months of the year totalled 156,000 tons.

The Coal Situation.

The imposing of licences for the importation of coal is one of the most unpopular measures yet enforced by the Minister of Public Works, except, of course, from the point of view of the colliery companies and of those who profess to believe that a prohibition of imports is a bold measure of national economy. In view of the protests from all classes of consumers, the Minister now affirms that it has not been found necessary to refuse more than a small percentage of the licences in order to save the home colliery industry from unemployment; but at the same time it appears that the French purchases of coal in South Wales have undergone a considerable contraction, it being stated that, from a total of 172,000 tons a week at the moment the licence decree was enforced, they fell within a month to 81,000 tons a week. The restriction of coal imports does not appear to have done much to improve the situation of the French colliery companies, and the Minister is now endeavouring to arrange for the carriage of coal from Dunkirk by sea to the various ports in order to compensate them for the loss of traffic in foreign coal, but it is thought that this attempt to give satisfaction to the ports will end in failure.

Midi Electrification.

The electrified line between Bordeaux and Hendaye, on the Spanish frontier, has been running for a month past and it was officially put into service on June 19th, when about one-quarter of the total of 1800 miles to be electrified was completed. A special train carrying the Minister of Public Works, engineers and other representatives of the various railway companies enabled the visitors to inspect the installations along the route, and on the return journey the speed attained was 75 miles an hour, occasionally reaching 78 miles. Energy is supplied from the Pyrenees under a potential of 150,000 volts to Pessac, where it is transformed to 60,000 volts for the line, and at the sub-station at Lamothe, near Arcachon, it is further transformed to 1500 volts for traction. The energy available from the Pyrenees will soon be increased by the completion of high-tension mains from the Alps and the Massif Central, and the surplus will be available for industrial and agricultural purposes. The standards span the line in ogival form, and even those who criticised the project from an æsthetic point of view now admit that the arrangement is satisfactory, apart from the simplicity and strength of such standards. For financial reasons it is not likely that the electrification of the entire system will be completed at as early a date as had been expected, and the Minister of Public Works was therefore exhorted to secure German aid under the Dawes agreement.

The Trans-Saharan Railway.

The construction of the railway across the Sahara Desert is the aim of the Comité du Transsaharien, which has just been constituted with the idea of emphasising the importance of the undertaking from the point of view of the country's security and prosperity and of aiding all preliminary work until the scheme is definitely put in hand. The committee insists upon the necessity of making the whole territory from North Africa to the Congo a continuation of the home country, which can only be accomplished by means of the railway. Its president, Monsieur de Warren, introduced a Bill into the Chamber of Deputies in favour of a credit of 18 million francs for the carrying out of a survey, but the Minister of Public Works now states that the Government itself has taken the matter up and is asking for a credit of 20 million francs to permit of three different surveys from Algeria. When the plans have been finally decided upon and the necessary credits voted the railway will be constructed on behalf of the State by, it is stated, the Paris, Lyons and Mediterranean Railway Company.

Automatic Wagon Couplings.

Experiments with automatic couplings for railway coaches and trucks have been carried out for many years, but nothing has been done by the respective Governments to facilitate the provision of funds for equipping the vehicles. A move has now been made by the Financial Commission of the Chamber of Deputies approving the proposal to equip railway vehicles with such devices, which means that it will sanction an expenditure of money on automatic couplings as soon as a definite type of apparatus has been selected. At present the only automatic coupling employed is the Boirault, which is used to a limited extent on suburban electric trains.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

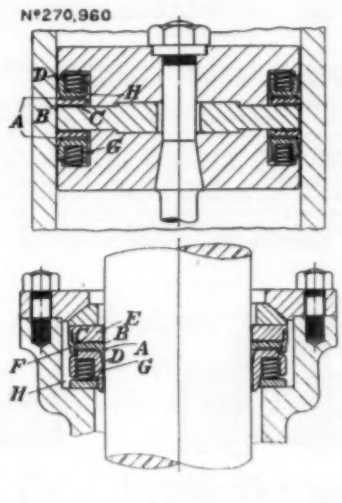
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

270,960. October 23rd, 1926.—IMPROVEMENTS IN METALLIC PACKING RINGS FOR PISTONS AND STUFFING-BOXES, Lancaster and Tonge, Ltd., Withington-street, Pendleton, Manchester; and Joseph Butterworth, High Meadow, Grosvenor-road, Swinton.

The packing ring A is L-shaped with an internal flange when used for packing cylinders and an external flange when used for packing rods. The flange leg B C is longer than the leg B D, and an angular projection turned on the packing ring at C bears against a washer E, which, however, is only used when packing rods, as shown in the lower illustration. The ring also fits tightly in the skirt F formed or screwed on the side of the washer

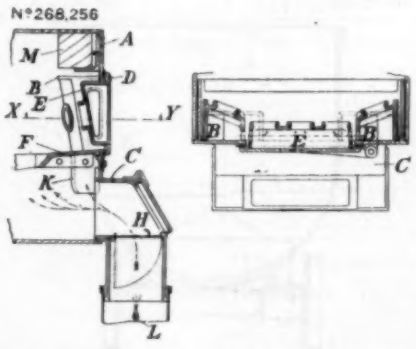


E adjacent to it. The leg B D of the ring A is turned taper and is much thinner than the other leg B C of the section. A bush G is fitted on the taper portion of the ring, leaving about 1/16in. between A and G. Holes are drilled in the bush G and springs are fitted as shown, so that when the parts E, A and G are fitted in a groove or recess the springs force the bush tightly on to the taper portion of the part A and also force the projection C tightly against the part E, thus tending to distort the ring A so that the part D is forced against the rod or cylinder. When used for packing a rod the ring A may be made in segments. When used for packing a cylinder the ring A, if in segments, is held together by the cylinder and the washer E is not required.—*May 19th*, 1927.

STEAM GENERATORS.

268,256. December 1st, 1926.—IMPROVEMENTS IN FURNACE FRONTS, James Howden and Co., Ltd., and James Howden Hume, all of 195, Scotland-street, Glasgow.

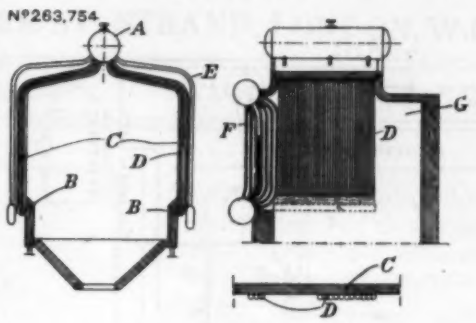
The furnace front described in this specification is of the type provided with means for delivering air under pressure to a point below the grate and equipped with deflectors designed to divert a proportion of the air so supplied to baffled spaces having discharge openings above and in front of the fire-bars. In the drawing A denotes the upper part of the front plate incorporating the firing door D, side baffles B, and baffle doors E. These baffles B E present Venturi openings by way of which air is distributed



evenly over the surface of the fuel resting on the fire-bars, and vanes may be fitted or cast in position in these openings to impart a vortex motion to the air and to ensure thorough admixture of the air with the gases rising from the fuel. C denotes the lower part of the front plate incorporating the air inlet duct attached to a trunk supplying air under pressure. H is a damper fitted to the inlet duct to shut off the air supply when ashes are to be removed. F is a dead plate with deflectors K presenting passages for deflecting part of the air supply to the upper parts of the spaces enclosed by the baffles, whilst M is a brick arch and L a steam nozzle.—*March 31st*, 1927.

263,754. November 2nd, 1926.—IMPROVEMENTS IN OR RELATING TO WATER-TUBE BOILERS HEATED BY RADIATION, Société Anonyme des Etablissements Delaunay-Belleville, of 1, rue de l'Ermitage, St. Denis (Seine), France.

The radiation boiler described in this specification has two layers of tubes connected with an upper drum A and separate lower drums B, one set of tubes being situated outside the walls C of the crown of the furnace, whilst the other set of tubes is situated inside the walls. The inside layer consists of continuous tubes D extending from the upper drum to the lower drums. The upper drum receives the feed water which flows into the lower drum through the tubes E. The tubes D exposed to radiation from the frame act as evaporative tubes, they touch one another and expose a continuous surface. The boiler can be combined with an ordinary boiler and the right hand view

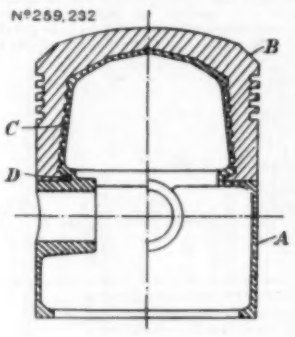


shows such a combination, in which the nest of tubes belonging to the ordinary boiler is shown at F. Liquid or pulverised coal can be supplied at the front part G of the furnace solely for the purpose of assisting ignition and increasing the radiation. The gases of combustion leave the furnace by traversing the first nest of tubes F of the ordinary boiler and subsequently traverse the other nests of tubes.—*May 26th*, 1927.

INTERNAL COMBUSTION ENGINES.

259,232. September 30th, 1926.—IMPROVEMENTS IN OR RELATING TO PISTONS FOR EXPLOSION ENGINES, Georges Edmond Jean Morin, of 30, rue de l'Avenir, Asnières (Seine), France.

The body A of the piston and the bosses for the gudgeon pin are composed of cast iron, whilst the top B of the piston is made

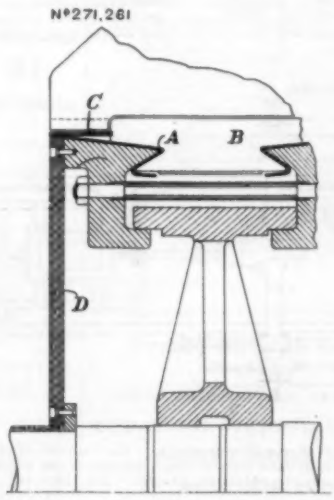


of aluminium or an aluminium alloy and has grooves for the piston rings. At the points C and D there are grooves, into which the aluminium or alloy penetrates during the casting process, and they serve for securing the aluminium top part of the piston to the cast iron body B.—*May 26th*, 1927.

DYNAMOS AND MOTORS.

271,261. June 16th, 1926.—IMPROVEMENTS RELATING TO DIRECT-CURRENT DYNAMO-ELECTRIC MACHINES, Gustaf Adolf Juhlin, of Thorold Croft, Broad-road, Sale; and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central Buildings, Westminster.

Flashes between the brushes of high-voltage rotary converters &c., are liable to damage the commutator, and the object of this



invention is to avoid this trouble. In order to protect the outermost portion of the mica lining A, which projects beyond the ends of the commutator bars B, from the effects of a flash over, a protecting sleeve C surrounds the outermost end of the lining A. This protecting sleeve, which can readily be replaced, may consist of a single piece cylinder made of paper and shellac and formed under pressure and with heat. The sleeve is clamped between the plate D and the commutator bars B.—*May 26th*, 1927.

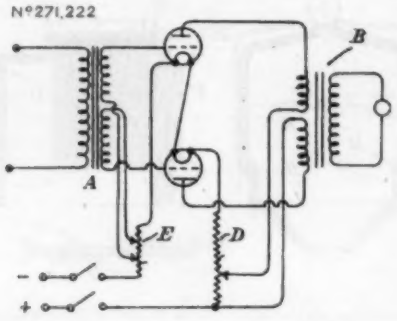
TELEGRAPHS AND TELEPHONES.

271,222. April 14th, 1926.—IMPROVEMENTS IN THERMIONIC VALVE AMPLIFYING SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; Reginald Charles Clinker, of "Tryfn," Bilton, near Rugby; and George Sail Campbell Lucas, of 28, Oxford-street, Rugby.

This invention relates to thermionic valve amplifying systems

in which, for the purpose of enabling a large output current to be obtained from valves of relatively small output, a pair of valves operating in a "push-pull" or parallel are employed. The object of the invention is to provide improved circuits whereby suitable anode and grid potentials are applied to each valve. It will be seen that the secondary winding of the input transformer A is divided as is also the primary winding of the output transformer B. The ends of the two sections of the primary winding of the transformer B are connected to suitable tappings on the resistance D, whilst the sections of the secondary transformer A are connected to tappings on a resistance E. It will be seen that the cathodes are connected in series and are connected through the resistances E and D to a source of supply. If commercial direct current power is used it will, of course, be necessary to employ a filter circuit.—*May 26th*, 1927.

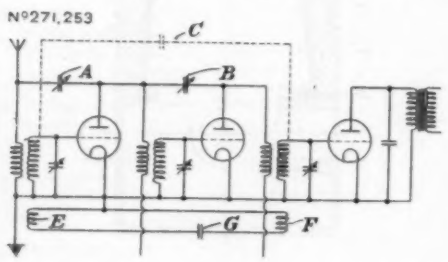
No 271,222



271,253. June 8th, 1926.—IMPROVEMENTS IN OR RELATING TO RADIO RECEIVING APPARATUS, Igranic Electric Company, Ltd., of 147, Queen Victoria-street, London, E.C. 4; and Peter William Willans, of The Cottage, Pattishall, Towcester, Northamptonshire.

It has been found that although electrostatic coupling between adjacent stages of a receiver be neutralised, it still tends to oscillate, and the object of this invention is to provide means of obviating this lack of stability. The diagram shows a three-valve

No 271,253



receiver having the usual stabilising condensers A and B, which are liable to become unstable from the presence of the capacity coupling C. This instability is neutralised by coils E and F connected in a closed circuit with the condenser G and coupled to the grid circuit inductances of the first and third valves. The coils E and F are mounted so that their position may be varied, and, as shown, the closed circuit is connected to the filament system.—*May 26th*, 1927.

MOTOR CARS AND ROAD TRAFFIC.

270,966. November 5th, 1926.—TACHOMETER FOR MOTOR-DRIVEN VEHICLES, Friedrich Hindorf, of No. 18, Kaiser-Wilhelm-Strasse, Wesermünde-Lehe, Germany.

The speed of a motor car is indicated in accordance with this invention by two dials, one of which is placed in front of the driver whilst the other is mounted at the rear of the vehicle,

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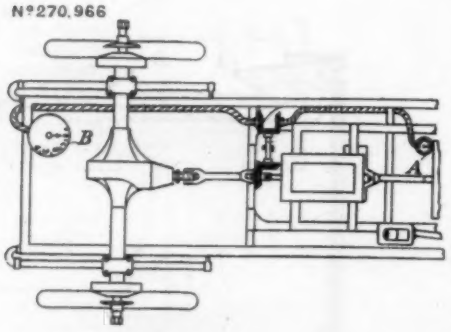


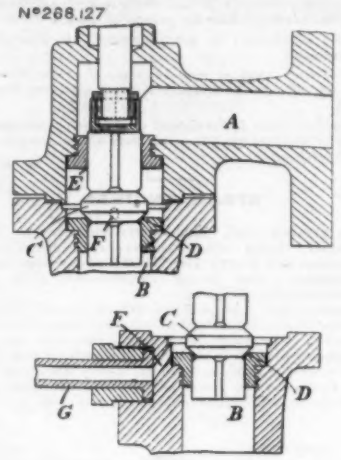
as shown at A and B respectively. The rotation of the cardan shaft is transmitted through bevel gearing to two flexible shafts which actuate the indicating devices.—*May 19th*, 1927.

MISCELLANEOUS.

268,127. March 20th, 1926.—IMPROVEMENTS IN GATE VALVES, Sir John Dewrance, of 165, Great Dover-street, Southwark.

This invention relates to stop valves of the sliding gate type commonly employed for controlling steam or water pipes of considerable size and fitted with a by-pass valve which also serves to control means whereby excess pressure which may be generated in the head of the valve may be relieved. The by-pass illustrated is provided with passages A and B communicating with the two sides of the main valve, a double-seated screw-down valve C being provided to regulate communication between the passage A and B. The valve C serves to prevent through communication by its contact with either of the seatings D and E, but permits of the passage of fluid through the by-pass valve when it is out of contact with both these seatings. Communicating with the space between these seatings D and E is a port F, which, by means of a tube G, leads to the hood of the main valve. Thus when the by-pass valve C is closed by its contact with either of the seatings D or E, the passage A or B,

No 268,127



as the case may be, is in communication with the hood through the port F and tube G.—*March 31st*, 1927.

271,156. February 18th, 1926.—IMPROVEMENTS IN OR RELATING TO VALVES AND COCKS, Vickers Ltd., of Vickers House, Broadway, Westminster, and Thomas Smith Duncan, of the same address.

While valves made principally of aluminium for use on aircraft are desirable from the point of view of reducing weight, it has been found that the metal is liable to tear at the bearing surfaces, and under certain conditions they seize. According to this invention the light metal stamping A is made in the ordinary way, but slightly over size. It is then bored out and a turned

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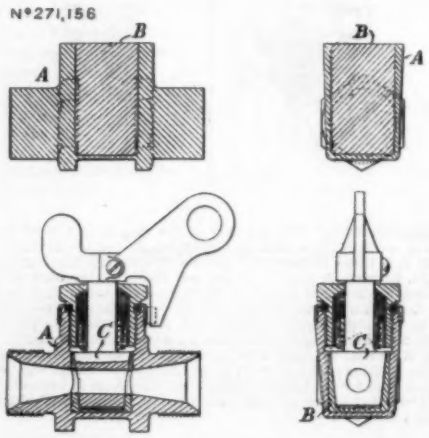

plug B of a different metal, such as brass, is forced into the bore-hole. The stamping is then returned to the drop hammer and after a preliminary heating it is placed in dies and finally forged to shape. The plug B is then bored to provide the seating for the valve member C.—*May 18th*, 1927.

271,797. March 24th, 1927.—IMPROVEMENTS IN METAL TRUCKS, Hermann Stier, of Elektro-Schweisswerk und Ingenieurbüro Hermann Stier, of Kaiserstrasse 8, Herne, Westfalia, Germany.

The truck described in this specification is built up of a U-

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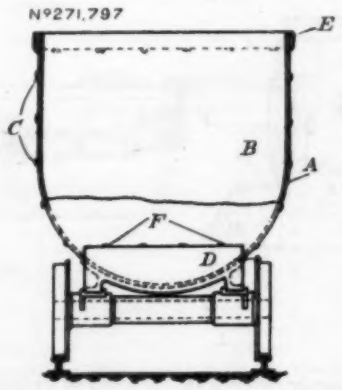

shaped plate or plates with two flanged end plates B attached by welding at intervals as indicated at C, where the joints are sprayed with zinc. The connections to the underframe D is made in a similar manner with welded joints F, and the same method is adopted for fixing the reinforcing ring E.—*June 2nd*, 1927.

271,327. October 29th, 1926.—IMPROVEMENTS IN THE METHOD OF AND APPARATUS FOR COOLING COKE, *Koppers Coke Oven Company, Ltd., of* 301, *Glossop-road, Sheffield.*

A method is described in this specification of cooling coke by means of a stream of gas such as carbon dioxide or nitrogen. Considerable difficulties have been experienced in the way of maintaining uninterrupted operation without discharging the cooling gas and admitting air to the hot coke at the bottom of the coke column, and the object of this invention is to overcome this trouble. The hot coke is discharged from trucks A into a sunk bunker B communicating with a shaft C which has several outlets D with dampers for regulating the discharge of the coke on to the conveyor E. Normally the discharge is continuous, and it is regulated so that the coke is adequately cooled before it leaves the shaft. The cooling gas is first fed into the coke column by means of a blower and pipes F and is drawn out

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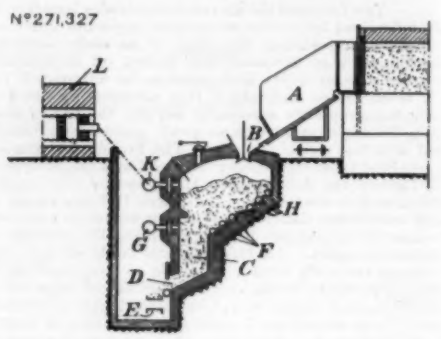

through a pipe G which conveys it to a second blower. This blower delivers the gas into the coke column again through pipes H and the hot gas then passes into a pipe K and may be used for heating a boiler L.—*May 26th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MINING ENGINEERS.—Summer meeting at Newcastle-on-Tyne. For Programme see page 638.

SATURDAY, JULY 2ND.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the Castleton Works of Messrs. Tweedale and Smalley.

THE INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Visit to the Sladen Valley waterworks of the Keighley Corporation. The party will assemble at the works at 3.30 p.m.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The Town Hall, St. Annes-on-Sea. North-Western District meeting. 10.30 a.m.

SATURDAY TO MONDAY, JULY 2ND TO 4TH.

NATIONAL INDUSTRIAL ALLIANCE.—Week-end Conference at the House of Retreat, Pleshey, Chelmsford.

FRIDAY, JULY 8TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The works of the London Brick Company and Forders, Ltd. South Midland District meeting. 11 a.m.

SATURDAY, JULY 16TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Chamber, Guildhall, Cambridge. Eastern District meeting. 2 p.m.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received orders for (*a*) fifty 50 H.P. tramway motors from the Manchester Corporation, this being the sixteenth order received by this company for tramway motors for that city; and (*b*) 100 type B 510 tramway controllers. This is the fourth order for controllers of this type from the same source.

STOTHERT AND PITT, Ltd., of Bath, have received an order from the Manchester Ship Canal Company for six electric gantry cranes to be installed at new docks at Ellesmere Port. The cranes have the "Stothert and Pitt" patented crank operated horizontal luffing system, and the lifting capacity is 2½ tons at 40ft. radius, or 2 tons at 45ft. maximum radius.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY has received an important contract for super-power station plant for the London Power Company. It covers the supply of two 35,000-kW turbo-generator sets for the Deptford West power station, situated on the south bank of the Thames at Stowage Wharf. The work will be carried out to the instructions of Dr. S. L. Pearce, O.B.E., engineer-in-chief to the London Power Company. The turbines will be two-cylinder machines of 35,000-kW maximum continuous rating, operating at 1500 r.p.m., with a steam pressure of 350 lb. per square inch and total temperature 700 deg. Fah. They will be arranged with a closed feed-heating and make-up evaporating system. The condensers are to be supplied by Richardsons, Westgarth and Co., Ltd. The alternators will be single-unit machines of 43,750 kVA capacity, generating at 6600 volts, three-phase, 50 periods. With the exception of the 50,000 kVA alternator at present being manufactured by the Metropolitan-Vickers Electrical Company for the Barton power station of the Manchester Corporation, they are the largest single-unit machines yet ordered for installation in Great Britain. They will be ventilated on the closed-circuit system, 70,000 cubic feet of air per minute being circulated for each machine. The circulation will be effected partly by fans on the rotor and partly by a separate fan. The overall length of each set will be approximately 70ft. Each complete alternator will weigh 133 tons, of which 52 tons is the weight of the rotor. The total weight of each set, including the condenser, will be nearly 500 tons.